REVUE AGRICOLE ET SUCRIERE DE L'ILE MAURICE

VOL. 40 - JANVIER - FEVRIER 1961 NO. 1

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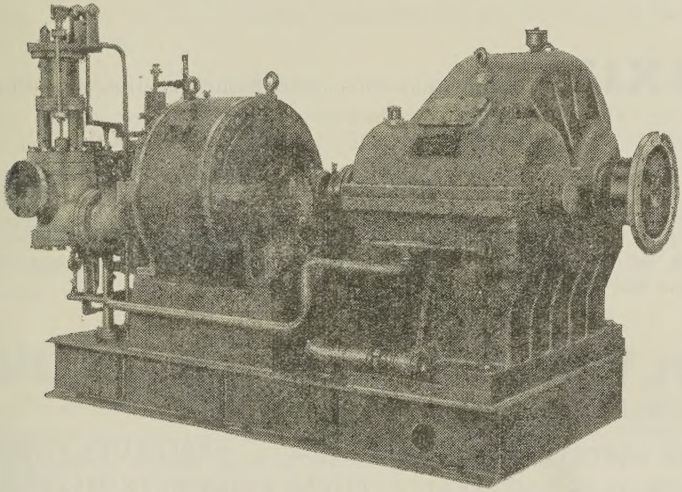

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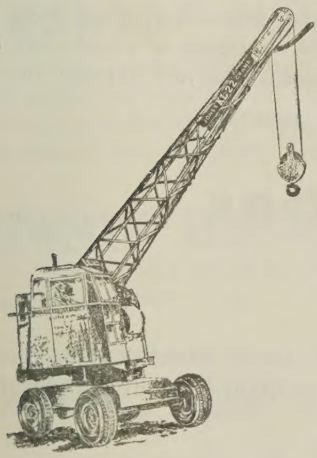

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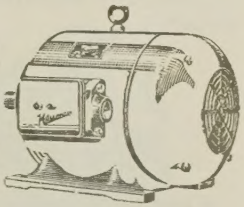

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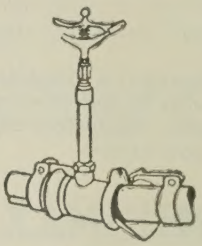

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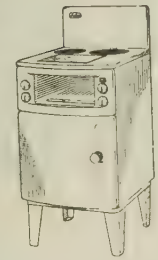
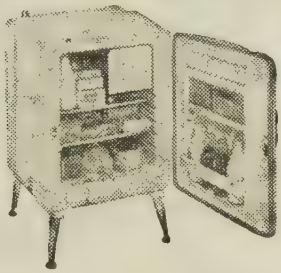


Also available with eye Level grill, four Boiling Plates, automatic control.

And now a **Jackson Refrigerator** built to the same high standards as the famous Jackson Cookers.



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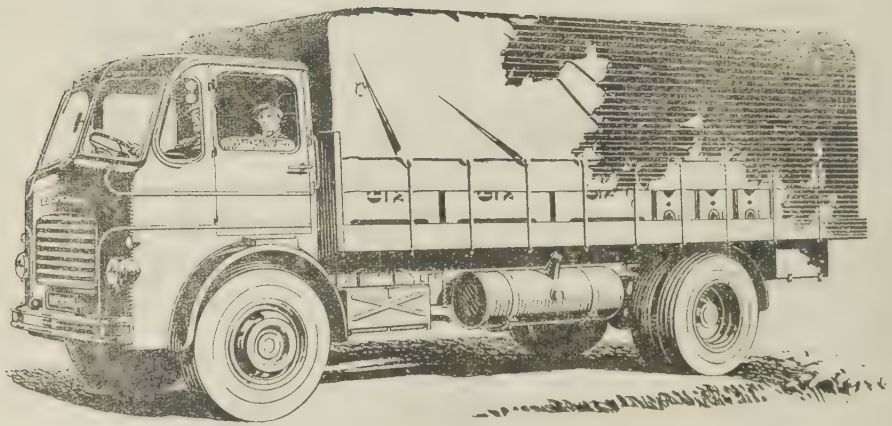

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REVUE AGRICOLE ET SUCRIÈRE DE L'ÎLE MAURICE

VOL. 40 No. 1 JANVIER - FÉVRIER 1961

SOMMAIRE

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Les manuscrits doivent parvenir au rédacteur, à son adresse, Vacoas, au moins *deux mois avant* la date de publication.

Lorsque les articles sont accompagnés de **schémas,** ceux-ci doivent être autant que possible du même format que la revue (18 x 25 cm. ou 7 x 10 pouces) ou occuper une page pouvant être pliée dans un sens seulement.

La rédaction accueillera avec reconnaissance des illustrations appropriées au texte de tout article ou mémoire ; les **photographies** devront autant que possible avoir les dimensions suivantes : 9 x 14 cm. ou 3 1/2 x 5 1/2 pouces et être faites sur papier glacé.

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1961

NOTES ET ACTUALITÉS

Les mouches des fruits

Il n'y a guère on a beaucoup parlé des mouches des fruits. Cette question retient depuis longtemps l'attention des Services Entomologiques du Département d'Agriculture. Ces mouches posent un problème technique très complexe. Précisons que pour le résoudre il faut plusieurs années de travaux soutenus, et l'on n'est alors même pas sûr d'obtenir les résultats escomptés. Il faut d'abord déterminer avec précision les diverses espèces de mouches, leur distribution dans l'environnement et les cultures auxquelles elles s'attaquent. Il faut ensuite établir soigneusement leur cycle de vie, combien de temps et à quelles époques elles sont à l'état d'œufs, de larves, de pupes ou d'adultes ; où les œufs sont déposés ; si les insectes opèrent la nuit ou le jour. Par surcroît, il faut déterminer de nombreux autres facteurs, tels que les effets de la saison, surtout de la température ambiante sur le cycle biologique. Ce sont là des facteurs que seuls les spécialistes peuvent déterminer, et peu de gens sont à même de se faire une juste idée du temps et du travail nécessaires pour établir les données de base sur lesquelles sera fondée l'organisation de la lutte contre ces ennemis. Peu de gens aussi savent que chacune de ces mouches se reproduit au taux de 10 à 18 générations par an donnant naissance à une population totale rarement inférieure à 500 individus et souvent allant jusqu'à 1,200 et plus. Le nombre total de ces insectes dans nos champs à certains moments peut donc se chiffrer par milliers.

Le problème du contrôle de ces ennemis se complique du fait que nous avons à Maurice au moins huit espèces différentes de ces mouches, dont la mouche de la région méditerranéenne, la mouche du Natal, les Dacus et la mouche des pommes d'amour.

Il est fort heureux cependant que la Section Entomologique du Département d'Agriculture, toujours vigilante, ait determiné les différentes phases de la biologie de ces insectes, aussi bien que de certains de leurs parasites. Ce travail qui a demandé de patientes études a été publié dans le numéro de Mai-Juin 1960 de la *Revue Agricole* (pp. 142-150) sous les signatures de MM. A.J.E. Orian, F.R.E.S. B.Sc. (hons.), Dip. Agric. (Maur.) et de M.L.A. Moutia, F.R.E.S., Dip. Agric. (Maur.), Entomologiste et ex-Entomologiste, respectivement, du Département d'Agriculture.

Notons que pas moins de 15 espèces de parasites des mouches des fruits ont été introduites à Maurice, élevées et multipliées en cage puis libérées dans différents secteurs du pays. Depuis 1957 les introductions massives de parasites ont été reprises et pas moins de 125,000 de ces parasites ont été libérés à ce

jour. Malheureusement deux seulement de ces quinze espèces semblaient vouloir prendre pied chez nous lorsque sont arrivés les épouvantables cyclones *Alix* et *Carol*, dont les effets dans ce domaine comme dans tant d'autres ont été catastrophiques. On ne se fait pas idée du retard qu'entraînent de tels accidents dans un travail de cette nature. Il est bon de se le rappeler et d'en tenir compte.

Nos techniciens cependant, en chercheurs avisés, ne se sont pas attaqués seulement aux moyens de contrôle par parasitisme. Des réalisations récentes à l'étranger dans la production des insecticides ont permis d'appliquer ici de nouveaux remèdes contre ces ennemis. On en trouvera les détails à la page 148 du numéro déjà cité de notre revue. L'emploi de ces moyens de lutte a déjà été expliqué à de nombreuses personnes et à tous les employés de la Section de Vulgarisation Agricole du Département d'Agriculture.

Une grosse difficulté subsiste : les différentes espèces de mouches demandent des traitements variables et les mesures de contrôle varient aussi selon les espèces de plantes cultivées. Malgré ces difficultés on a obtenu en pratique un contrôle efficace à 70 pour cent dans certains cas isolés. Notons cependant que lorsque le voisin ne fait rien pour se débarrasser de ses mouches, l'effort personnel a un effet bien moindre. Il faut donc au technicien dans ce genre de lutte la coopération de tous.

Le tableau de réussite, s'il n'est pas très encourageant jusqu'à présent pour ce qui est des arbres fruitiers, l'est beaucoup plus pour les légumes-fruits, notamment les cucurbitacees et les pommes d'amour, fruits de base dans l'alimentation journalière de toutes les classes de la population mauricienne. Ainsi, en employant le dipterex on a réussi a réduire l'infestation du *Pardalaspis* (mouches des pommes d'amour) de 86 à 10 pour cent.

Le Service de Vulgarisation s'emploie depuis trois ans à faire adopter des méthodes efficaces de lutte surtout contre les ennemis des curcubitacées et des pommes d'amour. Cet effort serait plus productif si l'on voulait suivre avec un peu plus d'énergie et de volonté les conseils donnés et adopter dans la pratique les méthodes préconisées et démontrées aux champs. La dernière en date des applications pratiques efficaces est l'emploi du "lebaycid", insecticide systémique à faible toxicité pour l'homme, qui exerce un effet délétère plus fort que le dipterex, aussi bien sur les larves que sur les œufs. Des expériences récentes faites par le Département d'Agriculture dans le nord de l'île ont donné une réussite de 75 pour cent sur les pêchers et de 100 pour cent sur la pomme d'amour.

Par ailleurs, en sus des envois des parasites des Iles Hawaii, le *Commonwealth Institute of Biological Control* s'est bien aimablement chargé de nous envoyer d'autres espèces parasitaires des mouches des fruits provenant de l'Afrique du Nord et de l'Australie.

Les notes ci-dessus font voir que les Services Agricoles sont très actifs au sujet de ce probleme.

" La Sucrerie de Canne " de M. Hugot

Lorsque parût en 1950 le manuel de M. E. Hugot, les technologistes sucriers du monde entier lui firent l'accueil le plus chaleureux. Un livre de cette importance devait immanquablement être traduit en anglais afin de profiter à la grande majorité des technologistes du sucre. Cette tâche a été accomplie par M. G. H. Jenkins, *Senior Lecturer* en Technologie sucrière à l'Université de Queensland. Par la même occasion, M. Hugot, conjointement avec M. Jenkins, fit une révision complète de son texte original ce qui fait de l'édition anglaise de son manuel le guide le plus moderne des ingénieurs sucriers. Le chimiste sucrier le trouvera aussi utile que l'ingénieur. Voici en quels termes *The Australian Sugar Journal* recommande ce manuel :

> " It can be strongly recommended as an excellent textbook for the technological student, as a reference book for the practising technologist and a source of virtually all the data or mathematical formulae that may be required in dealing with any problem that might arise in a sugar mill from day to day. It should occupy a place on the table — not the bookshelf — of every mill engineer or chemist for ready reference purposes ."

« Fertilizer Use »

Nous signalons la parution de « Fertilizer Use — Nutrition and Manuring of Tropical Crops » par Dr. A. Jacob et Dr. H. V. Vexhüll, traduit de l'allemand par Dr. C. L. Whittles.

Entre les moyens qui se prêtent à améliorer la production agricole, il y en a deux qui ont déjà prouvé leur efficacité : les engrais minéraux et les semences sélectionnées et productives. Les dix dernières années ont vu une extension considérable de l'utilisation des engrais minéraux dans de vastes régions des tropiques. L'importance de la fertilisation minérale est généralement reconnue. C'est une tâche beaucoup plus difficile que de communiquer les connaissances locales de cette utilisation aux intéressés. Elle a été tentée par le Professeur Jacob et le Dr. von Vexhüll qui ont recueilli des matériaux de premier ordre en étudiant minutieusement les travaux de 857 auteurs compétents et en y ajoutant leurs propres expériences. Ils y ont magnifiquement réussi. Leur manuel comprend 620 pages, 99 photos, 37 diagrammes, 102 tableaux. Ce manuel est considéré comme un guide sûr pour tous ceux qui veulent s'orienter sur les derniers résultats des recherches sur la fertilisation des cultures tropicales.

Le Bulletin Agricole du Congo Belge

Nul ne sait quel sera le sort éventuel de la recherche agronomique au Congo ex-belge. Par un hasard significatif, le numéro jubilaire du cinquantième anniversaire du *Bulletin Agricole du Congo Belge et du Ruanda-Urundi* a paru à quelques jours de la proclamation de l'indépendance du Congo. Ce numéro a été consacré à une synthèse d'une des réalisations les plus remarquables de la Belgique en Afrique, l'agriculture congolaise. Dans ce domaine, quelles qu'aient été

ses déficiences ailleurs, la Belgique cède au Congo tous les éléments d'un essor agricole prodigieux : une institution de recherches de renommée mondiale, une doctrine agronomique et une expérience agricole mûries dans des plantations et des élevages modèles, des entreprises forestières de haute tenue, des paysannats organisés.

« Le *Bulletin Agricole*, écrit M. P. Steiner, a été l'auxiliaire laborieux et utile des agronomes, des vétérinaires et des forestiers, le porte-parole écouté du monde rural. La variété et le caractère concret de ses articles reflètent l'ampleur des réalisations agricoles du Congo, l'esprit pratique et le sens du possible qui les ont caractérisées. Pendant cinquante ans, le *Bulletin Agricole* a établi un pont entre la recherche et l'application, fourni aux techniciens une documentation abondante, leur a donné l'occasion de communiquer aux autres le fruit de leurs études et de leurs travaux ».

Le fascicule jubilaire du *Bulletin Agricole* retrace l'historique du développement agricole en Afrique ex-belge sous tous ses aspects : recherche, agronomie, zootechnie, eaux et forêts, chasse et pêche, colonisation de 1885 à 1958.

Souhaitons que le *Bulletin Agricole* reprenne après les heures tragiques que vit le Congo, la place prédominante qu'il occupait parmi les publications techniques de haute tenue de l'agronomie tropicale.

Journée avicole à Réduit

Les Services Vétérinaires qui s'occupent aussi de l'élevage des oiseaux de basse-cour ont organisé une intéressante et instructive « Journée avicole » à Réduit le 21 janvier. Son Excellence le Gouverneur y consacra la matinée de ce jour. Les invités parmi lesquels se trouvaient des ministres, des hautes personnalités agricoles du pays, des éleveurs, des fonctionnaires, furent reçus par le Ministre de l'Agriculture et des Ressources Naturelles.

Le Ministre prononça à cette occasion une allocution dont le texte intégral a été publié dans les journaux. A moins de créer des pâturages en empiétant sur les terres cultivées en canne, le pays ne pourra jamais produire ses besoins en viande de boucherie. Il n'est pas aisé de faire cela dans les circonstances actuelles, mais nous pouvons quand même, avec les moyens modernes, y substituer dans une certaine mesure par la production intensive d'oiseaux de basse-cour. Il n'y a pas de raison pour que le pays ne se suffise pas entièrement en œufs et poulets, ce qui du même coup procurera du travail à beaucoup de gens. En vue d'atteindre ces objectifs le Gouvernement a créé un centre avicole qui devait être inauguré en Janvier 1960, mais les cyclones *Alix* et *Carol* bouleversèrent tous les arrangements sans cependant causer des dégâts aux installations.

Le centre avicole est équipé d'appareils modernes dont trois incubateurs pouvant recevoir 2,000 œufs chacun. Il y a une quarantaine de poulaillers séparés et un aménagement de litière profonde pour 500 sujets.

Le centre a commencé de fonctionner vers la fin de 1959. Il a déjà produit

4,500 poulets et sera en mesure de mettre à la disposition des éleveurs environ 30,000 poussins d'un jour tous les ans de Mars à Octobre. Outre cet aspect particulier, le centre sert aussi à des expériences de nutrition et des meilleurs moyens d'élevage dans les conditions locales.

Au cours de cette « Journée », une visite a aussi été faite au Laboratoire de Pathologie Animale où l'on prépare les vaccins contre la maladie de Newcastle, la maladie de Carré et d'autres maladies. C'est à ce laboratoire que l'on s'est aperçu que ce n'était pas à une déficience de calcium qu'il fallait attribuer — comme on l'avait fait jusqu'ici à Maurice — un état pathologique des bovins, principalement des vaches laitières, mais à une carence de cobalt.

Puis les visiteurs ont pu voir une démonstration de la technique d'insémination artificielle appliquée aux bovins.

A propos du fourrage

Dans ce numéro nous publions un compte-rendu par M. W.A. Wright, B.Sc., Dip. Agr. Sc., A.I.C.T.A., *Senior Agricultural Officer* en charge des stations expérimentales du Département d'Agriculture, des travaux faits aux diverses stations d'essais, notamment à Réduit, Richelieu, Curepipe et Palmar, sur les herbages prometteurs d'introduction récente à Maurice. Ce compte-rendu a été radiodiffusé par le *M.B.S.* le 4 Novembre de l'année dernière. Il résume de façon très succincte, en un langage simple et clair et à la portée de tous ceux que cette question intéresse les travaux récents accomplis dans ce domaine au Département d'Agriculture. Nous espérons que la publication de cet article attirera sur ce sujet plus d'attention que la causerie radiodiffusée qui semble être passée quelque peu inaperçue.

En bref

Il n'y a pas eu jusqu'à la mi-février, où ces notes ont été écrites, de pluie substantielle chez nous. L'Ile Maurice est soumise à une sécheresse depuis le jour de Noël quand elle fut bien arrosée en général, quoique la quinzaine finissant au 31 Décembre ait été déficitaire dans son ensemble. Depuis plusieurs semaines l'on n'enregistre pas de croissance chez la canne dans les parties basses du pays et l'on estime que le manque à gagner dans ces localités atteint déjà de 7 à 10 pour cent.

Si ces conditions se prolongent, la coupe prochaine sera compromise. Ce serait vraiment malchanceux qu'une mauvaise année, cette fois grâce à la sécheresse, succède à 1960 où la récolte a été tellement déficitaire. En effet, le pays a produit en 1960 seulement 235,578 tonnes métriques de sucre contre 580,372 tonnes en 1959, soit une réduction de 61 pour cent en comparaison de la moyenne annuelle des trois dernières coupes. Le rendement de sucre à l'arpent a été de 1.25 tonne en comparaison de 3.17 tonnes en 1959 et 1.28 tonne en 1945, année aussi de cyclone catastrophique, où la réduction a été de 49 pour cent. Le rendement en cannes à l'arpent a été 12.8 tonnes en 1960.

Le Fonds d'Assurance contre les Cyclones et Sécheresses a payé jusqu'à fin Février 1961 des compensations se chiffrant à environ 130 millions de roupies pour les pertes subies par les planteurs sucriers à la suite des cyclones *Alix* et *Carol*. Le Fonds qui se montait à environ 124 millions de roupies à la fin de l'exercice 1959-60, ne disposera plus que d'environ 20 millions de roupies pour faire face à toute éventualité en 1961. Rappelons cependant que le Fonds est ré-assuré en partie contre les pertes occasionnés par les cyclones.

La sécheresse a été intense dans les parties nord de la Province du Cap de Bonne Espérance où il n'est pas tombée de pluie depuis quatre ans. N'ayant plus de fourrage des fermiers ont dû transférer leurs troupeaux de moutons au Natal et au Transvaal. De Septembre à Novembre les chemins de fer du Sud-Afrique ont transporté plus d'un million cinq cent mille moutons vers des pâturages plus fertiles. De nombreuses fermes ont été abandonnées.

A l'Ile de Guernsey on vient d'inaugurer une installation de distillation de l'eau de mer dans le but d'irriguer les plantations de tomates et de fleurs qui constituent deux des plus importantes industries de cet île de la Manche. L'installation a coûté près de Rs. 3½ millions. C'est la première du genre dans un pays tempéré. On a estimé qu'il coûterait moins cher de distiller l'eau de mer que de créer de nouveaux réservoirs pour le stockage de l'eau de pluie. Le procédé employé est nouveau et relativement peu coûteux grâce à des progrès techniques récemment mis au point par la maison C. et J. Weir, Ltée de Glasgow.

Le Ministère de l'Agriculture et des Ressources Naturelles s'occupe activement d'obtenir la coopération des planteurs, grands et petits, pour une plus ample production de denrées alimentaires. Nous croyons savoir que la *Mauritius Sugar Producers' Organisation* a promis de faire un effort spécial dans ce sens et s'engagera à mettre une certaine superficie sous culture vivrière en 1961. Par ailleurs, on estime que les planteurs cultiveront de leur côté une superficie du même ordre, alors que les maraîchers assureront la production de toute différence.

Le 25 Février le Bureau du Secrétaire Colonial annonçait la nomination de M. A. North Coombes, O.B.E., au poste de Directeur des Services Agricoles. M. Coombes se retirera du Service Civil le 1er Octobre prochain.

IN MEMORIAM

Le 13 Janvier est décédé à Moka, Monsieur Alfred Leclézio, à l'âge de 82 ans.

Alfred Leclézio obtint son diplôme d'Ingénieur (Civil et Mécanique) en 1902 au Central Technical College de City & Guilds à Londres. Il fit ensuite un stage dans la firme A. & P. W. Mc Quie, Ltd. de Glasgow, puis rentra à Maurice en 1904 pour devenir un Partenaire et Directeur des Forges Coloniales (Tardieu & Cie.) Après la fusion de cette firme, en 1931, pour la formation des Forges Tardieu Ltd., Alfred Leclézio continua à en assumer la direction, avec ses collègues Esnouf et Coutanceau, et contribua pleinement, de par ses fonctions mêmes au développement de nos sucreries.

Leclézio comptait parmi les plus anciens membres de l'Institution des Ingenieurs Civils de Grande Bretagne, ayant appartenu à cette corporation pendant plus de 50 ans.

Alfred Leclézio était doué d'un esprit éclairé et progressif et avait pleinement compris la part que joue la main d'œuvre dans l'économie de toute entreprise moderne. Il marqua sa sollicitude pour ses artisans de façon éclatante lorsqu'en prenant sa retraite en 1958, il fit un don généreux pour la création de l'Association des Employés des Forges Tardieu permettant ainsi aux ouvriers de cette firme d'en devenir des actionnaires.

Allié à ces grandes qualités de cœur, Alfred Leclézio ajoutait celles du parfait gentleman. Nombreux donc furent ceux, de toutes les classes de la communauté mauricienne, qui lui rendirent un dernier hommage lors de ses funérailles.

En M. Leclézio la Société de Technologie Agricole et Sucrière et le Conseil d'Administration de la Revue Agricole perdent un de leurs plus anciens membres, dévoué à la cause du progrès technique de son pays.

Alfred Leclézio, au cours de sa longue vie, ne s'est pas limité aux questions d'intérêt scientifique seulement. Il était le Président des Conseils de Fabrique de la Cathédrale St. Louis et de l'Église de St. Pierre-ès-liens. Il a aussi servi à Maurice la cause de la culture française, en particulier, comme Secrétaire, puis comme Président de l'Alliance Française. C'est pour les eminents services rendus à cette cause qu'il fut élevé à la dignité d'Officier de La Légion d'Honneur.

La *Revue Agricole* prie la famille éprouvée par ce deuil de bien vouloir agréer l'expression de ses condoléances émues.

Nous regrettons également d'anoncer le décès de M. Geoffrey Corbett survenu en Angleterre le 27 Décembre 1960.

Après des études d'horticulture faites à Kew, M. Corbett géra une entreprise de café et de cacao en Ouganda avant d'entrer dans le Service Colonial Britannique en 1922 année où il devint *Agricultural Superintendent* à Rodrigues. C'était le moment où le Docteur Tempany s'efforçait de mettre sur un pied viable à Maurice, l'industrie du tabac qui avait été jusqu'alors des plus précaires. M. Corbett fut envoyé au Sud Afrique, en Rhodésie et au Nyasaland pour étudier la culture et la préparation du tabac. A son retour, il fut affecté au développement de cette industrie qu'il organisa de toutes pièces sous les directives de Tempany et du *Tobacco Board*. En 1932 il fut nommé *Government Tobacco Officer*, poste qu'il occupa jusqu'en 1947 année où il obtint un transfert avantageux comme *Agricultural Officer* à Chypre.

Pendant 23 ans Geoffrey Corbett a servi l'industrie moderne du Tabac à Maurice et on peut dire qu'il en a été le principal artisan.

Nous prions Madame Corbett et ses enfants de bien vouloir agréer l'expression de nos vives condoléances.

LA SUCRERIE DE LABOURDONNAIS

Notes Historiques

par
GUY ROUILLARD

Après avoir fonctionné pendant 140 ans, la sucrerie de Labourdonnais a éteint ses feux l'année dernière pour ne les rallumer que sur la terre d'Afrique, à Hippo Valley en Rhodésie du Sud.* Le moment est donc opportun de faire un court historique de cette propriété.

L'emplacement actuel de la sucrerie faisait partie de la concession Tréhouart, accordée à cette famille en 1777.

En 1814, M Jean Baptiste Germain fit l'acquisition de ces terres, qui couvraient une superficie de 186.8 arpents, de M. Joseph Staub, et érigea la sucrerie. La date exacte de sa construction n'est pas connue, mais il est à remarquer que le nom de J.B. Germain ne figure pas dans la liste des propriétaires de sucreries qui sont mentionnés dans l'Almanach de Maurice de 1820.

La preuve que M. Germain a été le créateur de la sucrerie nous est donnée dans l'acte de vente fait en faveur de M. Jacques de Chasteigner Dumée en 1821. Voici ce qu'il y est dit : " La dite habitation sur laquelle M. et Dme. Jean Baptiste Germain ont fait construire de leurs deniers et sans emprunt plusieurs des bâtiments y existant dont :

1° Un bâtiment de 35 pieds carrés en charpente couvert en paille renfermant un moulin à manège composé de trois cylindres en fer avec 4 chaînes en fer pour atteler les bœufs et 8 jougs.

2° Un bâtiment en maçonnerie servant de sucrerie, de 50 x 35 pieds, contenant 4 chaudières montées, cuillers, écumoires, cuves et barriques, formes à sucre et autres objets de la sucrerie.

3° Trois charrettes, jougs et chaînes.

4° Une cloche montée.

5° Six outils de tonnellerie et ustensiles aratoires, arbres de moulin.

6° Quarante bœufs de manège et de charrois.

7° La dite habitation, etc. "...

*Ce n'est pas la première fois qu'une sucrerie mauricienne sera exportée de toute pièce. En 1878 M. Desperis fit l'acquisition d'une sucrerie à Flacq, appartenant à l'Oriental Banking Corporation et qui avait cessé de fonctionner à la suite d'une grande sécheresse. Il la fit démonter pour la faire reconstruire en Afrique du Sud, les machineries ayant été transportées à bord du voilier Umgeni. Cette usine est aujourd'hui la centrale de Mount Edgecombe, une des plus belles de l'Afrique, fabriquant plus de 100,000 tonnes de sucre annuellement.

La sucrerie de Labourdonnais en 1960.

Timbre d'1 cent émis en 1950.*

Timbre de 4 cents émis en 1954.*

*Reproduction autorisée.

M. Jacques Dumée contribua beaucoup au développement du domaine de Labourdonnais. En 1821 la superficie de ce bien était de 203 arpents ; à la mort de M. Dumée en 1847, elle était de 1,400 arpents.

Le terrain Chauveau fut acheté en 1838 et comprenait 289.15 arpents.

Mon Repos, qui comportait une sucrerie, et ses annexes *Mon Chagrin* et *Grand Champ*, formant 366 arpents appartenant à M. Hypolite Boulle, furent annexés en 1839. Ce fut la première centralisation faite par Labourdonnais.

En 1847 " Henry Adam & Cie ", maison dont M. Christian Wiehe était un des associés, fit l'acquisition de Labourdonnais pour la revendre l'année d'après à Mmes. J. R. Bourgault Ducoudray et Aubin. Après le décès de M. Bourgault ses filles, Mmes. Christian Wiehe et Aristide Aubin, devinrent les seules propriétaires de Labourdonnais.

M. Christian Wiehe prit alors la direction de la propriété qui fut depuis ce temps, donc pendant plus d'un siècle, toujours administrée par un membre de la famille Wiehe. Les attaches de cette famille à la terre de Labourdonnais sont lointaines, puisque la grand'mère maternelle de M. Christian Wiehe était née Tréhouart de Longpré, famille qui fut concessionnaire dès 1777, comme il est dit plus haut, et puisque d'autre part Madame Christian Wiehe, née Bourgault du Coudray était la petite fille de M. Jacques Dumée.

En 1852, la propriété fut agrandie de 435 arpents par suite de l'acquisition de *La Caroline* qui appartenait à Monsieur Antoine Sériès.

A cette époque Labourdonnais possédait un moulin à vapeur et un vide, qui fut avec celui de Phœnix, le premier installé dans l'île. La batterie à la Malartic fut alors vendue à Mon Loisir Rouillard, et elle se trouve jusqu'aujourd'hui à l'emplacement même où elle fonctionnait alors.

En vue de l'établissement des Chemins de fer dans le Nord, une portion de terre fut vendue au Gouvernement en 1863.

En 1875, la sucrerie de Forbach* qui appartenait aux mêmes propriétaires (Wiehe et Aubin) fut démolie et les terres annexées à celles de Labourdonnais dont la superficie fut portée à 2912 arpents. Elle était la même lorsque la Société « Wiehe Souchon » en fit l'acquisition en 1894. Par la suite, cette société vendit une partie de la propriété y compris Forbach, et était ainsi réduite à 1,762 arpents lors de la formation de *The Labourdonnais S. E. Co. Ltd.*, en 1915. M. Nemours Harel ayant acheté la part de Sir Louis Souchon, dont la mère était née Wiehe, entra comme actionnaire dans cette nouvelle compagnie.

* *Forbach* : Cette sucrerie fut créée en 1818 par M. Joseph Staub qui était originaire de Forbach en Alsace. Nous voyons jusqu'aujourd'hui la tour du moulin à vent qui fonctionnait encore en 1852.

Plus tard Labourdonnais racheta presque toutes les terres vendues, dont *Ferret* (230 arpents) en 1936 et *Forbach* (663 arpents) en 1939. En 1950 une autre partie de l'ancien Forbach (167 arpents) appelé *Couroupas*, appartenant à Mme. Noël Lecornu & Cie., fut de nouveau annexée et, enfin, 233 arpents de l'*Espérance* furent achetés à la Société Maurice Souchon en 1953. La superficie totale de Labourdonnais dépassait donc 3,000 arpents au moment de la fermeture de l'usine en 1960.

Le verger de Labourdonnais fut créé sous la direction de M. Payet que M. Christian Wiehe fit venir de la Réunion à cet effet. Quelques années après, en 1858, la construction du château était terminée par les soins de M. Rampant, architecte qui construisit la première église de Ste. Thésèse à Curepipe. La belle allée d'arbres de l'Intendance conduisant au château a été plantée par M. Dumée.

La sucrerie et les travaux de culture n'étaient pas pour cela négligés: bien au contraire, la réputation de cette propriété modèle était déjà bien établie dès cette époque et suscitait l'admiration de tous ceux qui la visitaient. Laissons plutôt parler les voyageurs étrangers qui furent reçus à Labourdonnais :

"*Ramble round Mauritius, circa* 1855" par G. Clark :

"At about eleven miles from Port Louis may be seen one of the finest estates and most admirable plants of a sugar factory in the colony: this is *Labourdonnais* the domain of C. Wiehe Esq., one of the first in Mauritius if not the first, in which sugar was produced by the vacuum pan. Everything concurs to render a visit to this estate pleasant to the traveller. The plantation laid out with great judgement, and cultivated with the greatest skill, the well-kept roads shaded with trees, the comfortable lodgings, the happy appearance of the labourers ; the splendid stables with numerous mules in the finest condition ; the well kept garden producing the finest fruits and vegetables to be seen in the colony, the sugar house with every improved process in operation, and a mansion worthy of the whole, combine to render Labourdonnais one of the most attractive estates in the colony. An elephant, the only one in the colony is kept there. He was brought to this island when quite young, about twenty years ago, and has been for the last fifteen years located at Labourdonnais, where he leads a very easy life... ".

"L'Ile Maurice et la Société mauricienne", *Revue des Deux Mondes* 1861, par Louis Laurent Simonin :

"Peu de sucreries présentent dans les colonies une aussi heureuse disposition que celle de Labourdonnais, décorée à juste titre du nom de sucrerie modèle. Peu d'habitations coloniales offrent une plus splendide installation que la villa attenant à l'usine. Construite dans un style emprunté d'Italie, mais où on a su tenir compte des exigences et des habitudes des pays tropicaux, la villa de Labourdonnais développe majestueuse-

ment ses quatre façades ornées d'une double galerie. Après nous avoir fait visiter son usine dans tous les détails, le maître du logis, M. Wiehe, nous conduisit dans des magnifiques jardins... M. Wiehe nous montra aussi son parc-aux-biches où une trentaine de ces gracieuses bêtes, prises dans l'île même, étaient assises paisiblement. Nous rencontrâmes à la sortie de Labourdonnais un majestueux éléphant appartenant à la propriété. "

C'est à la requête de feu M. Adrien Wiehe, père de M. Georges Wiehe, dernier administrateur de ce magnifique domaine, que la variété de canne BH 10-12 fut introduite à Maurice, en 1920. Cette canne fut cultivée et étudiée pendant une dizaine d'années à Labourdonnais avant d'être propagée dans l'île, où elle devait jouer un rôle important dans l'économie du pays à un moment où le pays manquait de cannes nouvelles pour remplacer les variétés défaillantes.

Si la sucrerie de Labourdonnais n'était pas entièrement équipée de machineries ultra-modernes, son efficience cependant était parmi les meilleures de l'île et sa tenue inégalable. C'est d'ailleurs à cette sucrerie que l'extraction record de Maurice fut obtenue en 1957 avec 14.98 de sucre % cannes, la polarisation étant de 98.5°. La Commission Economique de 1948 fit les éloges de cette usine qui, disait-elle, était placée pour être une des belles centrales du Nord. Le sort en décida autrement.

Dans quelques années une cheminée et quelques murs seront les seuls témoins de cette sucrerie qui fit l'admiration de tous, faisant école parmi les techniciens de l'industrie sucrière mauricienne. Souhaitons que la sucrerie d' " Hippo Valley " en Rhodésie soit à la hauteur de celle qui fut Labourdonnais à l'Ile Maurice.

Ne pouvant conserver la sucrerie, mais étant désireux de continuer à vivre et à travailler sur la terre de leurs ancêtres, les Wiehe et leurs associés ont conservé 1,250 arpents de l'ancienne partie de la propriété qui continuera à porter le nom célèbre de Labourdonnais. The *Beau Plateau Ltd.*, société nouvellement formée par Messieurs Harel et Cie., comprendra la différence, dont une partie des terrains Boullé et Chauveau, Couroupas et Espérance.

LABOURDONNAIS FACTORY — 66 YEARS OF PROGRESS

It seems worth while recording the evolution of Labourdonnais Factory from its re-modelling in 1894 to its final year of crushing in 1960. The notes given below covering this period have been prepared at the Editor's request by Mr. Adrien Wiehe. For the period 1894 to 1937 they have been reproduced from « The Evolution of Sugarcane Culture in Mauritius », by A. North Coombes, 1937, p 148-151, where they were originally published.

YEAR	ALTERATIONS AND ADDITIONS TO EQUIPMENT	Commercial sugar extracted o/o cane	Commercial sugar extracted o/o sucrose in cane
1894	Double dry crushing. Whole factory re-modelled and triple effect substituted for *batterie à feu nu*.	8.47	—
1895	*Save all* fitted to triple effect. Pump for removing acidulated water. Cane carrier. ...	9.07	—
1896	Syrup tanks. Triple effect air pump increased ...	9.12	—
1897	Bagasse carriers to furnaces. Air pumps for vacuum pans modified. . .	8.20	—
1898	Donkey pump for feeding boilers. Rails for feeding centrifugals set up. ...	9.03	—
1899	Elevator for massecuite. A large filter-press. ...	10.03	—
1900	Electric light. Outlet pipe of one effect of evaporator enlarged. ...	9.89	—
1901	Massecuite distributed automatically to centrifugals. ...	9.46	—
1902	Smith's cane-shredder. ...	9.77	—
1903	Second triple effect. Imbibition adopted. ...	9.97	—
1904	Juice heaters using extra steam from triple effect. *Save all* fitted to second triple effect. ..	10.35	—
1905	Massecuite waggons. Laboratory. New boiler ...	10.15	75.7
1906	Third mill. Five Danek filters for juice Automatic scum pump for feeding filter-presses. Four new syrup settling tanks. Additional boiler. ...	10.42	—
1907	New vacuum pan (23 tons strike). Two Worthington pumps for elevating juice. ...	11.16	81.5
1908	Rotary sieve for sugar. . .	11.50	84.0
1909	A boiler renewed. ...	11.08	—
1910	Eight Pott-Cassel suspended centrifugals (30" diam). New building to house centrifugals and crystallizers. ...	12.21	81.4

YEAR	ALTERATIONS AND ADDITIONS TO EQUIPMENT	Commercial sugar extracted o/o cane	Commercial sugar extracted o/o sucrose in cane
1911	Triple-circulation furnaces for boilers. ...	11.48	79.4
1912	Cane-unloader (Sugar MachineryCo.). ...	11.63	80.4
1913	Barometric condenser. Air pump. 15 crystallizers (600 c. ft. capacity). 2 first-curing centrifugals (48" diam). Steam engine of 140 H.P. Suction gas engine of 15 H.P. Massecuite receiver. « Tables » and massecuite waggons abandoned.	11.52	75.8
1914	Vacuum pan (25 tons strike). ...	10.75	75.4
1915	Closed-type juice heaters. 2 boiler feed pumps ...	11.20	74.2
1916	Second mill replaced by new mill manufactured in the Colony by Forges et Fonderies, Ltd*. ...	10.84	77.1
1918	Musgrave ventilator-fan. One first-curing centrifugal (48" diam). ...	10.90	78.3
1919	Central steam pipe connecting the five boilers ...	11.00	78.3
1920	Quadruple effect of 10,000 sq. ft. heating area replacing the two triple effects. ...	10.44	76.3
1921	Economizer. Cane-unloader, 5 tons load (American Hoist and Derrick Co.) ...	9.74	74.5
1922	Crusher (Fawcett-Preston with Krajewski-grooved rolls) replacing cane-shredder. ...	10.37	73.3
1923	Intermediate cane-carrier. Main cane-carrier modified. Cane-cutter installed. ...	10.45	75.7
1924	One 15-ft. boiler replaced by 18-ft. boiler. ...	10.04	78.1
1925	One 15-ft. boiler replaced by 18-ft. boiler. ...	10.19	73.7
1926	Three 15-ft. boilers replaced by three 18-ft boilers. Steel steam main replacing cast-iron main from boilers to mills. « Marais » syphon tube to remove condensed water from last effect of evaporator Extraction syrup pump for evaporator. Cylindrical juice measuring tanks with conical top and bottom One plate and frame filter-press (300 sq. ft. filtering area). Sulphitation tank. Liming tanks.	9.70	73.8
1927	Ten settling tanks of 300 c. ft. capacity for defecated juice. Six Philippe filters. Independent drive for cane cutter.	10.30	77.8
1928	Five crystallizers with water-cooling pipe arrangement. Automatic lubricating devices for mills.		

*Workshops in the island are equipped to make many types of sugar machinery.

YEAR	ALTERATIONS AND ADDITIONS TO EQUIPMENT	Commercial sugar extracted o/o cane	Commercial sugar extracted o/o sucrose in cane
	« Richard » recording apparatus to control juice measurements, steam pressure, chimney draught and vacuum in pans. Some cast-iron cog-wheels replaced by steel cog-wheels. Apparatus for the preparation of milk of lime. ...	10 81	80.8
1929	Six Pott-Cassel suspended centrifugals (30" diam). New and improved sugar bins and sieve for sugar. « Zerolit » water purifier for boiler feed water. Automatic scaling apparatus for evaporator.	10.74	83.6
1930	First mill replaced by new Mirrlees Watson mill fitted with intermeshing rollers. Alterations to boilers. Electric plant. Main for exhaust steam connecting all mills.	11.20	83.0
1931	Steel pipes connecting boilers to air pump and centrifugals.	11.14	82.1
1932	Cast-iron pinion and cog-wheels of second mill replaced by steel pinion and cog-wheels.	11.07	82.8
1933	Settling tanks abandoned in favour of defecators 10 of which, fitted with heating surface, installed. Six plate and frame filter-presses (350 sq. ft. filtering area each). Modification to water-cooling pond. ...	11.86	86.7
1934	Introduction of electrolytic chlorine plant (E. C.). Hydrolically operated clutch Esnouf patent) ...	9 90	81.1
1935	Six automatic pressure regulators for filter-presses (Ménagé patent). ...	12.24	86.8
1936	15 ton travelling crane over mills. Factory water piping improved. Brass pump and pipes for all raw juices. ...	13.46	87.1
1937	5 crystallizers in motion (600 c. ft. capacity). ...	12.26	87.63
1938	Addition of lateral feed table. Installation of new main cane carrier equipped with roller chains and metallic slats. One set of heavy-duty cane knives from Mirrlees Watson driven by 125 HP steam engine. Crushing rate 40 T.C.H. ...	13.41	87.12
1939	Alterations to crusher including replacement of Krajewski roller by Fulton-type rollers. ...	11.18	85.93
1940	No improvements to equipment during the war period.	11.71	86.61
1941		12 75	88.17
1942		13.02	87.85
1943		13.52	88.48
1944		13.03	87.00

YEAR	ALTERATIONS AND ADDITIONS TO EQUIPMENT	Commercial sugar extracted o/o cane	Commercial sugar extracted o/o sucrose in cane
1945	New 200 HP high speed steam engine for centrifugal station. Addition of heater, liming station and pumps for separate treatment of secondary juice. ...	12.45	84.29
1946	Replacement of juice pumps and boiler feed pumps.	12.92	88.92
1947	Extension of mill building over boiler plant and erection of new building for boiling house Relocation of heaters and filter stations. ...	13.73	89.26
1948	Addition of one 1200 sq. ft. high velocity juice heater ; replacement of open defecators by one Bach continuous juice clarifier. Crushing rate 45 T.C.H. ...	13.72	88.34
1949	Replacement of two coil pans by two 35-Ton calandria pans from A. & W. Smith including erection of new metallic staging. Relocation of existing pans. Enlargement of cooling pond and addition of 4000 g.p.u. steam driven centrifugal pump for hot water from condenser ...	13.48	86.85
1950	Replacement of 14 — 30" x 18" water-driven centrifugals by 14 — 36" x 18" belt driven centrifugals from Watson Laidlaw. Replacement of two 18 ft multitubular boilers working pressure 125 p s.i.g. Replacement of smoke tube economiser by 10.000 sq. ft. gilled tube economiser from E. Green & Sons. ...	13.28	86.85
1951	Installation of turbine driven air compressor and masse cuite receiver. Addition of two magma mixers. ...	11.74	85.13
1952	Replacement of 2nd & 3rd mills by two modern units including gearings and engines, intermediate carriers, accumulators, etc. Complete overhaul of live and exhaust piping of mill house. Crushing rate increased to 50 T.C.H. ..	12.37	86.99
1953	Erection of new feed table on metallic staging equipped with roller chains and steel slats. Replacement of raw juice pumps. Installation of automatic weighing scales for mixed juice and imbibition water. Replacement two 18 ft multitubular boilers working pressure 125 p.s.i.g. ...	11.55	87.17
1954	Installation of new liming station. Replacement		

YEAR	ALTERATIONS AND ADDITIONS TO EQUIPMENT	Commercial sugar extracted o/o cane	Commercial sugar extracted o/o sucrose in cane
	of filter presses by rotary vacuum filter from Dorr-Oliver. Addition of one 25 tons coil pan...	12.35	88.15
1955	Replacement of " C " massecuite belt driven centrifugals by three semi-automatic high speed water driven centrifugals from Watson Laidlaw. Replacement of chain pumps for A, B & C massecuites by Rota pumps. Installation of automatic weighing scale and 1000 tons capacity steel storage tank for molasses including pumping station. Replacement of one 18 ft multitubular boiler — working pressure 125 p.s.i.g. ...	13.85	91.23
1956	Replacement of 10,000 sq. ft. Evaporator by 15,000 sq. ft. Q. Effect evaporator from Forges Tardieu Ltd. Replacement of vapour piping and barometric condenser — crushing rate 55 T.C.H. Erection of concrete building for laboratory equipped with modern instruments & apparatus.	14.39	90.16
1957	Installation of one 600 KVA turbo-alternator. Partial electrification of factory including water, juice, syrup & massecuite pumps, main cane carrier, bagasse conveyors, crystallizer drive, etc. Addition of steam superheaters & surplus valve to two boilers supplying steam to turbo alternator. ...	14.98*	90.95
1958	Alteration to first motion gearings of all mills so as to increase circumferential speed of rollers to 30 ft per minute Mills fitted with feeder rollers. Crushing rate of factory increased to 60 T.C.H. . .	13.52	89.18
1959	Erection of new metallic building for crystallizers and centrifugals stations. Addition of electrically driven cane leveller. ..	13.78	89.48
1960	Replacement of 14 belt driven Watson Laidlaw centrifugals by 3 Broadbent 48" x 30" automatic electrically driven centrifugals. Installation of dry sugar elevator, two metallic sugar bins — 100 tons capacity each — and modernisation of weighing, bagging and loading stations ...	10.59**	84.38

*Record for Mauritius

**1960 will go down in Mauritius sugar annals as the year of the worst cyclone ever recorded in the South Indian Ocean area. The result on the sugar crop was disastrous both for yields of canes and sugar content.

DISEASES OF FILAO *CASUARINA EQUISETIFOLIA* FORST IN MAURITIUS

by
G. ORIAN
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CONTENTS

I — INTRODUCTION

The filao tree *Casuarina equisetifolia* Forst., known in Australia as beefwood tree from the red colour of its wood, and sometimes also as Australian pine, has long been largely planted for fuel and timber along the coast in Mauritius and occasionally at higher elevations inland.

Disease causing death of the tree was first officially reported in the island in 1917 and one form characterized by the production of an abundant mass of sooty spores in the bark, and hence termed smut disease, was associated with the fungus *Trichosporium vesiculosum*, discovered by Butler in India. As, however, trials to infect filao with the fungus repeatedly failed here, its parasitic nature was questioned and its presence on the dead and dying trees was considered to be of purely secondary nature. In spite of intensive investigations at the time, the agent responsible for the death of filao trees in the island remained undetermined.

In April 1948, the attention of the writer was drawn to an outbreak of disease on young filao plants on an estate in Grand Port district and as a result of the studies which were effected, its causative agent was proved to be *Pseudomonas solanacearum* (E. F. Smith) Dowson, the bacterium causing the wilt of a large number of plants, chiefly members of the Solanaceae. As the organism was subsequently found on diseased trees in most of the affected areas in the island, it is now considered to be the chief cause of the death of filao trees in Mauritius.

Death of the trees in the island also occasionally results from attack by the honey agaric *Armillaria mellea* (Fr.) Quél.

Just as with the early investigators, numerous attempts by the writer to infect *Casuarina equisetifolia* artificially with the smut fungus failed. He, however, finally found that young filao plants could pick up a mild infection upon inoculation of the fungus into wounds made in the stem ; it is therefore possible that *Trichosporium vesiculosum* may, under certain circumstances, be able to act as a primary cause of death of the tree.

During the course of the present study, the following diseases were found on filao in Mauritius, the last five being only of minor importance :

Bacterial wilt
Smut disease
Armillaria rot
Scaly bark disease
Bark cracking disease
Bark splitting disease
Witches' broom
Seed spot

The following fungi, all of them very likely only saprophytic, have been obtained in culture, or otherwise observed on the plant : Diplodia, Pestalotia, Rhizoctonia, Fusarium, Rhizopus, Xylaria, *Ustulina zonata* (Lev.) Sacc., *Hexagonia lignosa* Lloyd, *Hypoxylon annulatum* (Schwein. ex Fr.) Mont, *Phytophthora cambivora* (Petri) Buisman.

Various bacteria were also obtained in culture, which failed to prove parasitic.

II — EARLY HISTORY OF FILAO DISEASE IN THE ISLAND

The first official record of a disease attacking filao trees in Mauritius is a letter No. 524/17 dated 30.5.17 from the Director of Forests to the Director of Agriculture, reporting the death of trees on the " Pas Géometriques " at Poste Lafayette in Flacq district, on the east coast of the Island. A scale insect had been supposed to be responsible for the death of the plants, but D. d'Emmerez de Charmoy, the Entomologist of the Department of Agriculture, who investigated the disease, came to the conclusion that the insect, which was identified as *Aspidiotus* (*Donidia*) *aurantii* Maskell, although occasionally causing slight infestation of the trees, could in no way be regarded as a pest of the plant. As a result of a survey then made, diseased trees were observed at widely scattered places in the coastal plantations in various districts, being present on an alarming scale occasionally (9).

In an unpublished report dated 12.11.17, d'Emmerez stated that the filao trees were suffering from

> " a root disease affecting trees of various sizes and causing the sudden death of young plants and the darkening and decay of the heart of older trees ".

A little later, d'Emmerez reported that investigations would tend to prove that the filao trees were suffering from a root disease caused by a species of Polyporus.

There was at the time no mycologist attached to the Department of Agriculture and, as owing to the war then raging it was considered uncertain to send material for examination in Europe, specimens and photographs of the diseased trees and of the supposed Polyporus were forwarded in December 1917 to F. A. Stockdale, then Director of Agriculture in Ceylon, for favour of examination.

No copies of the photographs sent have been available to the writer, but in a note on the subject, d'Emmerez stated that one of them showed

> " the transverse section of the trunk of a diseased tree (20 years old). The splash-like dark markings in the central portion of the wood and the speckles at the periphery exude when the tree is felled a red brown gummy substance ".

In a letter dated 20.1.18, Stockdale forwarded a report by T. Petch, Mycologist of the Department of Agriculture of Ceylon, in which it was stated that the specimens from the trees affected with the root trouble showed a disease similar to one which Dr. E.J. Butler, Imperial Mycologist to the Government of India, had studied on filao in that country in 1905. In an article on the subject (8), Butler had attributed the disease to a fungus which he had named *Trichosporium vesiculosum*. On 17th. July, 1919, a letter was received from Petch, stating that he had forwarded the Polyporus which had been collected on dead filao stems in Mauritius to C.G. Lloyd, who had named it *Hexagonia lignosa* and considered it as probably only saprophytic.

In Mauritius, further observations tended to show that the filao disease was then spreading to a rather alarming degree and on February 15th., 1919, legislation was passed (Proclamation 4 of 1919) declaring the Crown Lands of the Colony and the Pas Géométriques infected or supposed of being infected with the Trichosporium disease. On 19th. March of the same year, a special officer, Mr. Philippe Cantin, was appointed for work under the general direction of the Entomologist of the Department of Agriculture with the the object of determining the life history of the pathogen, the mode of spread of the disease and the means by which it could be controlled.

On September 8th. 1919, a memorandum on filao diseases (12) was presented to the Board of Agriculture by Dr. H.A. Tempany, Chairman of the Board and Director of Agriculture, in which it was stated that :

> " amongst dead trees, some are usually encountered in which the bark is raised up into great blisters and eventually ruptured as the result of the formation of a black powdery substance consisting of myriads of spores.....
>
> It seems possible that the disease may in reality be due to two separate and distinct fungi ; in one the production of an abundance of black spores is a characteristic feature, in the other the formation of spores is absent. While this cannot be regarded as certain, it is convenient to refer to the form in which spores are present as the *smut disease*, while that in which spore formation is not characteristically apparent may be termed *dry-rot*.....
>
> Both dry-rot and smut occur together and may possibly constitute a single entity....."

Following the opinion arrived at by Butler in India the Trichosporium fungus was at first considered responsible for the death of the filao trees in the island, but experimental infection with the spores of the fungus inoculated under the bark and spread over the soil failed to determine the disease on healthy plants grown at Réduit (1). Moreover, laboratory investigations yielded several fungi, none of which, however, could be made to reproduce the disease experi-

mentally (2). Through repeated failure to prove the parasitic nature of the Trichosporium fungus, the opinion was reached in 1923 that the fungus

> " appears to be able to attack a tree only after it has been weakened by the root parasite or some other cause " (3).

In a report in 1923, a French translation of which appeared in the " Revue Agricole de Maurice " (11), E. F. S. Shepherd, who had been appointed Botanist and Mycologist of the Department of Agriculture, reviewed the situation and pointed out that

> " so far, no organism has been discovered associated with diseased filao tissue which has been proved to be parasitic ".

On March 28, 1924, a letter bearing the number 55/26 was received from Dr. Small, Mycologist at the Biological Laboratory of Kampala in Uganda, informing Dr. Tempany of the occurrence of a root trouble of *Casuarina equisetifolia* in that territory and asking for information about the Mauritius disease. In another letter (No. 60/26 of September 9, 1924), Dr. Small mentioned the despatch of a reprint of a paper wherein the fungus fatal to the tree in Uganda was described. The writer has not had access to that paper, but in a minute dated 20.11.24 (9), Shepherd wrote :

> " The symptoms of the disease described by Dr. Small though being somewhat similar to, do not appear to be exactly the same as, those encountered in the filao disease here. Furthermore a Rhizoctonia has never to my knowledge been isolated from diseased filao roots in Mauritius..... "

The trouble in the case of the Uganda disease thus appears to have been associated with a species of the fungus Rhizoctonia.

In 1927, considerable losses were caused by the so-called smut disease in certain coastal plantations and in June of that year, another legislation was passed (Proclamation 26 of 1927), providing for the destruction, removal, disposal or treatment of diseased Casuarina trees in infected or supposedly infected areas.

The disease continued to be observed in many of the coastal plantations, but for some twenty years, no outbreak of severe importance was apparently recorded.

III — BACTERIAL WILT DISEASE

(a) *Discovery of the causative agent of the disease*

In April 1948, a report was received from an estate in Grand Port district, to the effect that filao plants were dying in a young, about 15 months old plantation on the estate. An inspection was effected on the thirtieth of that month and diseased plants were brought back for study.

In the laboratory, an abundant white to dirty-white gum ooze was produced from freshly-cut surfaces of the diseased stems and it was suspected that the disease was caused by *Pseudomonas solanacearum* (Smith) Dowson, the bacterium responsible for the wilt or brown-rot of solanaceous plants chiefly. A bacterium was obtained in culture which was inoculated into tomato plants, but absence on illness interrupted the work for several months.

The investigations were resumed towards the close of the year, when advice was sought by an estate on the coast of Savanne district, where tall trees were reported to be dying. Upon inspection, gum ooze was also found to be produced from the cut surfaces of the diseased trees. The ooze was found to be rather copious in a few cases, but scanty or absent in others (4). The trees appeared to show more susceptibility to the disease in badly drained soil than under normal conditions (7).

The technique employed for isolating the pathogen was to disinfect the bark of a portion of stem with methylated spirit and flaming, after which portions of convenient size were cut with a sterile knife on a flamed wooden block, a bill-hook disinfected with alcohol and flaming being used for large trunk portions. The bark was sometimes removed before disinfecting with alcohol. The selected portions were placed on a previously sterilized technolite slab under a disinfected bell jar and left for about fifteen minutes to exude the gum, which was transferred aseptically to slants of peptone-saccharose agar (*) (Wilbrink's medium) ; or else, small pieces of freshly-discoloured wood were removed with a sterile scalpel from the disinfected stem portions and directly cultured.

Dilution cultures of the bacteria obtained proved in many cases to be already pure. No growth, however, sometimes resulted from the dark-brown to black beads produced. Fungi were also frequently obtained in culture, but they were discarded at first, as not being the type of organism sought for. Probably exactly the contrary was done in the earlier studies by d'Emmerez and others, when in their search for a supposed fungus pathogen, bacterial growths obtained were probably rejected as contaminants.

Inoculations into young filao and tomato plants with a number of the isolates from the gum were successful. The causative bacterium was reisolated from the inoculated filao plants and produced typical wilt when reinoculated into tomato plants, thus proving definitely that *Pseudomonas solanacearum* was the factor, or one of the factors, causing the death of filao trees in the island (5).

In spite of the fact that the cause of the disease responsible for the death

* Wilbrink's medium is of the following composition :

Saccharose	... 10 g.
Peptone	... 5
Potassium phosphate K_2HPO_4	0.5
Magnesium sulphate ...	... 0.25
Agar	... 10
Water	... 1000 mls.

of filao trees in the island seemed to have been worked out by 1949, the writer repeatedly returned to the subject in subsequent years, because as already said, the presence of the bacterium, as characterized by the gum exudation typical of *P. solanacearum*, could not always be ascertained in dying tall trees examined. It could thus have been possible for some other virulent organism besides *P. solanacearum* to exist which could also be primarily responsible for the death of filao trees showing otherwise internal symptoms similar to those attributed to that specific bacterium. Were such to be the case, that agent could not, however, be determined by the writer until the time he retired from office in 1958 ; the chances are that it is simply non-existent.

We are thus confronted with the following situation : On very young trees, the gum ooze is easily produced, whereas on old trees, it becomes less abundant, is often difficult to ascertain, or is even apparently altogether absent. Again, in the case of dark-coloured ooze, the gum may prove to be sterile. Furthermore, in one and the same patch of diseased trees, ooze production can be detected on some trees, but not on others.

One explanation could be that the development of the bacterial wilt bacterium is gradually hampered during the slow progress of the disease over a number of years in such a hardwood plant as the filao, the pathogen being finally ousted by antagonistic action from secondary organisms and disappearing more or less completely towards the last stages of the disease on the plant. This could also explain in part the failure of the early researches on the disease.

(b) *The identity of the pathogen confirmed abroad*

1 — One of the isolates obtained from filao was forwarded to the Commonwealth Mycological Institute on 7th October 1949, with the following note :

> " Culture B/14 (isolated from *Casuarina equisetifolia*) is definitely *Xanthomonas solanacearum*. Inoculated tomato plants showed the usual wilting and customary ooze of gum. Sterile potato cylinders are blackened. "

In reply, Dr. S. P. Wiltshire, Director of the Institute, quoted Dr. W. J. Dowson, of the University of Cambridge, as follows :

> " As regards Orian's B/13, B/14 and B/15, the first two are certainly *Pseudomonas solanacearum* ". (Letter 1267/52/1 Maur. dated 21.5.52).
> (B/13 was an isolate which had been obtained from the Tecoma tree.).

2 — The following extracts from correspondence with Dr. Arthur Kelman, Professor of Plant Pathology at the North Carolina State College, U.S.A., are also quoted :

> " I am enclosing a copy of a letter sent to Dr. Lelliott concerning

> an evaluation of certain cultures of *P. solanacearum* that we have recently completed. You will be interested to know that one of your cultures which was stored in the National Collection of Plant Pathogenic Bacteria since 1949 is still highly pathogenic on tomato. In the listing of the National Collection, the host from which this isolate was obtained is not shown and I would be very much interested to know what the origin of this culture was..." (letter to the writer dated August 18, 1959).

In the letter to Dr. Lelliott (of the Ministry of Agriculture, Fisheries and Food, Harpenden, England), Dr. Kelman wrote :

> " We do not have a listing of the host from which isolate No. 253 was obtained in Mauritius by Orian. There is no question as to the high pathogenic potential of this isolate and its validity as a culture of *Pseudomonas solanacearum* ".

The culture listed as No. 253 by the National Collection of Plant Pathogenic Bacteria was referred to as Orian's B-14 in the report accompanying Dr. Kelman's letter to Dr. Lelliott ; it was thus possible for the writer to trace what the origin of the culture was and on 3.11.59, he replied to Dr. Kelman as follows :

> " Culture No. 253 (Orian B-14) was isolated from the filao tree *Casuarina equisetifolia* Forst. on 4.1.49 ; it was identified as *Ps. solanacearum* and was forwarded to the Commonwealth Mycological Institute in October following (letter to C.M.I. dated 7th. Oct. 1949) ".

The identity of the Casuarina pathogen had thus been confirmed both in England and America, but it should be noticed that the strain isolated from the filao in Mauritius was found in U.S.A. to give still 100% infection on tomato seedlings after it had been kept in culture for ten years (1949-1959) ; a rather uncommon fact as *Pseudomonas solanacearum* is known to show rapid attenuation of virulence in culture.

(c) *Symptoms of the disease*

On young one to two-year-old plants, the disease is first characterized by the filiform, jointed branchlets, generally referred to as needles, and which play the part of leaves in Casuarina, slowly turning yellow and falling off one by one, so that diseased plants are easily picked out in a plantation at that stage.

As the disease progresses, the plants dry out from the tips backwards, until the death of the whole plant occurs. A black discoloration of the bark works up the stem externally from the base, often extending on one side of the stem only. On removing the bark in such areas, a dull grey-black colour is observed, with the cambium layer turned brown. Beneath the dead bark, the woody cylinder is seen to have turned brownish-black to varying depths.

PLATE I

Phot. 1 — Tree in centre attacked by bacterial wilt. (Plantation at «La Plaine», Ferney S. E. in Grand Port district). Photographed 7.11.49

Phot. 2 — Filao trees at Richelieu allotment area in Black River district, attacked by bacterial wilt. Smut was present on most of the trees towards the last stages of the disease. Photographed 3.2.49

Phot. 3 — Cross section of stem of filao tree from Richelieu. Photographed 4.2.49. Note the jagged appearance of the diseased central wood and the speckles at the periphery, which are characteristic symptoms of the bacterial wilt disease.

Phot. 4 — Portion of stem of dead filao tree from Richelieu, showing the epidermis ruptured through the production of smut spores Photographed 4.2.49

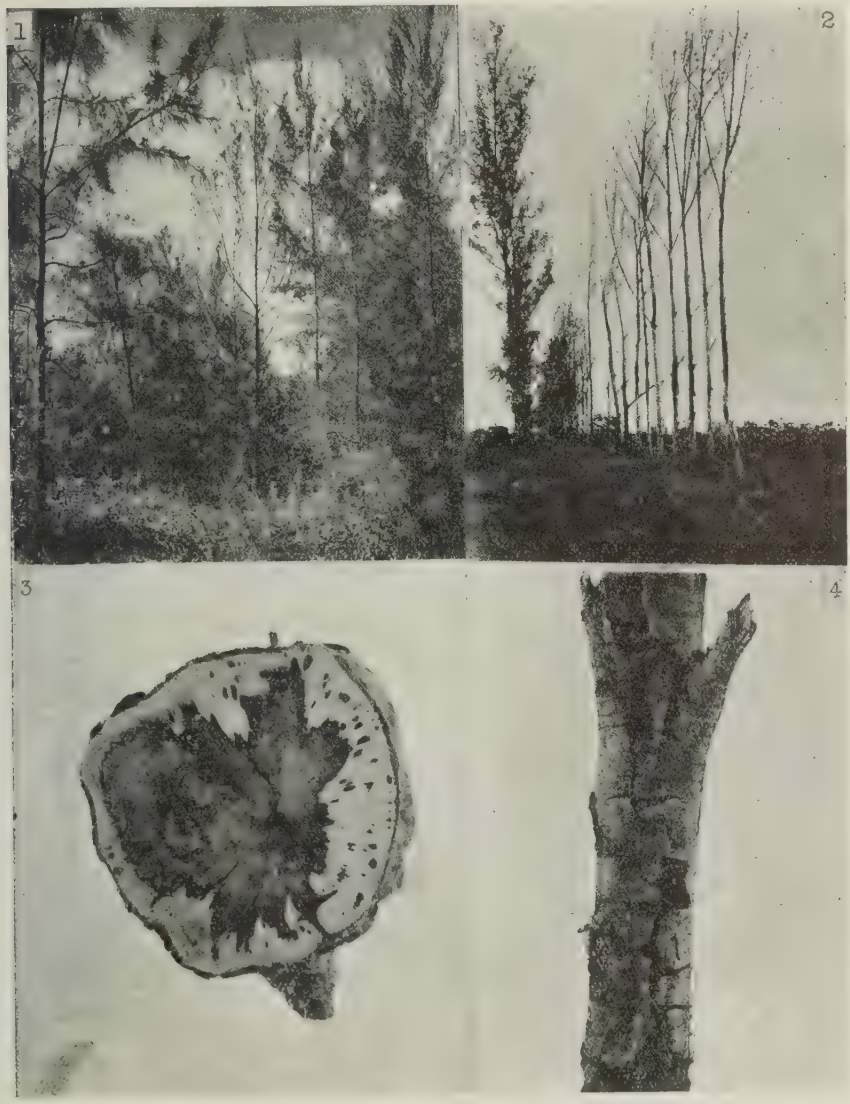
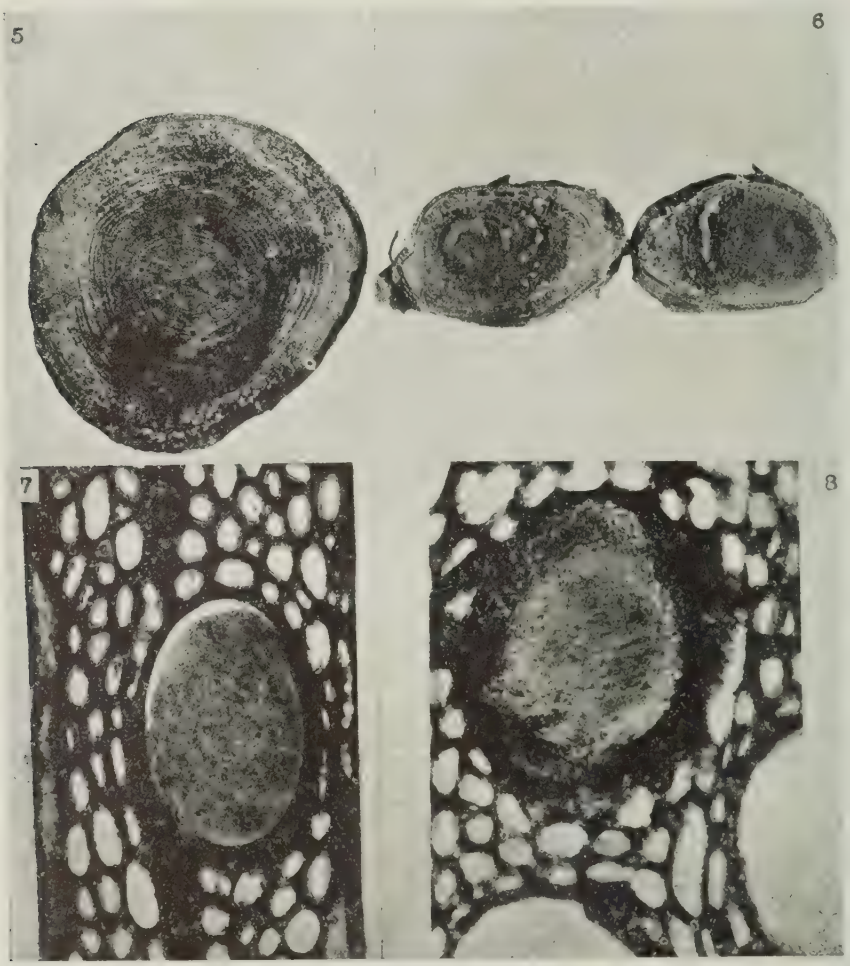


PLATE II

Phot. 5 — Stem of filao tree from Bel Air Montocchio in Savanne district, left overnight in a moist atmosphere. Probably a recent attack, as the central wood had not darkened in the manner considered typical of the bacterial disease. Note the gum exudation. Photographed 6.11.48.

Phot. 6 — Root portions of diseased filao tree from Bel Air S. E. left overnight in a moist atmosphere. Note ooze of bacterial gum. Photographed 6.11.48.

Phots. 7 and 8 — Photomicrographs of transverse sections of the stem of young filao plant attacked by bacterial wilt, showing a large wood vessel blocked with gum (x 435). Photographed 13.10.49



In the badly-diseased portions of the stem, the discoloration of the wood is very uneven in cross section, and irregular, brown, water-soaked patches alternate with creamy-white portions of the wood. A white ooze is abundant after a few minutes, as small drops all over the surface, visible even to the naked eye (phots. 5 and 6). On the dead wood, however, no ooze is produced, but it is more or less abundant in regions surrounding the dead part.

On tall trees, the loss of the needles by the side branches works up from below upwards, the death of the branches also occurring in the same order until the tree finally dies (phots. 1 & 2). In a cross section of the stem, the affected region, much jagged and hence of very irregular outline, is observed to be of a dark colour about the centre (from Drab-Gray to Light Brownish Drab (10)) ; it is bordered by a very narrow zone much darker than the remainder of the affected area (up to Deep-Brownish Drab and nearly black) ; that zone offers a water-soaked appearance at places. Brown, water-soaked patches of varying sizes occur between the projecting portions of the dark central wood and in the outer, still apparently healthy part of the stem (phot. 3).

No gum ooze, save occasional brown-coloured droplets, is produced by the inner parts of the wood long dead, but it is, in general, more abundant near the periphery of the affected parts, or in the isolated diseased patches in the affected regions of the stem. On tall trees, the production of gum from cut surfaces is however very erratic ; it is very often scanty, when a hand lens and careful search, or keeping for a time in a moist atmosphere, may he necessary for the detection of but a few typical beads. In many cases, no ooze at all is observable, although the jagged appearance of the dark central wood and the speckles at the periphery indicate the presence of the bacterial disease. The exudate is dirty-white in colour when produced by newly-affected tissues ; otherwise the colour varies from various shades of brown or brownish-red to nearly black ; yellow beads are also sometimes seen.

We must recall here that in the note concerning one of the photographs sent to Stockdale in Ceylon in 1917, d'Emmerez drew attention to

> " the splash-like markings in the central portions of the wood and the speckles at the periphery which exude when the tree is felled a red-brown gummy substance '. (Letter 4120/17 of December 14,1917).

This is a clear indication that the filao disease spoken of in these early days was the same as the one which we have proved to be caused by *Pseudomonas solanacearum* (Smith) Dowson.

We must also note that filao trees affected by the bacterial disease also very often show the vesicles of *Trichosporium vesiculosum* in the last stages of the disease (phot. 4), when the smut can be no other than secondary in nature.

(d) — *Possible presence in diseased filao trees of secondary organisms antagonistic to the filao bacterium*

Owing to the fact that tall filao trees attacked by the bacterial wilt organism often fail to produce gum ooze from freshly-cut stem surfaces and that dark-coloured ooze sometimes proves to be sterile, occasional attempts were made to find out if secondary organisms present in diseased filao wood tissue could not exert an antagonistic action towards the bacterial pathogen.

The Trichosporium fungus, two Fusarium isolates and three species of bacteria, tested in that connection, failed to show such antagonism. The following experiment, however, gave some positive indication to that effect.

On 6.8.56, three tubes of melted peptone saccharose agar were inoculated with one loopful each of a dilute suspension of the Casuarina bacterium and poured in Petri dishes. Small bits of wood from a diseased filao tree were aseptically removed and stuck in the centre of the Petri dish, one bit each, into the solidified agar.

On 9.8.56, two of the Petri dishes had become overgrown by a quick-growing bacterium, but colonies of the filao bacterium were completely absent. As some possibility could have existed for the rapid-growing organism being an innocent contaminant, the dishes were discarded.

In the third Petri dish, however, the filao pathogen from the bacterial suspension had grown as minute, thickly-seeded, uniformly distributed colonies, and a thick growth of a white bacterium had grown out of the inserted piece of wood. A distinct, transparent halo, two to four millimetres wide was present around the white growth, proving the latter to be definitely antagonistic to the filao pathogen.

There are thus reasons to believe that absence of gum production from cut surfaces of tall diseased filao trees showing otherwise the internal symptoms of the bacterial disease, is due to the elimination of the causative bacterium through antagonistic action by secondary invaders. It seems therefore logical to consider all diseased filao plants showing the jagged dark-coloured central wood (phot. 3) and "the speckles at the periphery" as being affected with the bacterial disease, even though gum ooze from cut stem surfaces is absent, and cultures of the diseased wood fail to give the correct bacterium.

Attention must be drawn here to the fact that filao stems, chiefly if diseased, sometimes produce a brownish-red, resinous or glassy exudate from some of the cut vessels ; such ooze should not be confounded with the gum ooze characteristic of *Pseudomonas solanacearum*.

(e) *Inoculation of the Casuarina pathogen on tomato*

On 11.9.48, two *tall* tomato plants each were inoculated with suspensions in sterile water of 18-hour-old transfers of two isotates which had been obtained in the preceding month of May. Numerous minute pricks were made with a sterile needle through a drop of the suspension at three different places along the stem of the plants. By 12.10.48, no wilting had been produced, but brown

longitudinal lesions had developed externally on the plants from the inoculated areas, a black discoloration was observed internally both in the vascular bundles and in the pith and dirty white gum drops were produced by affected stem portions of all four plants left overnight in a moist chamber.

On 19.1.49, nine *young* tomato plants were inoculated with seven cultures of the bacterium isolated on 4.1.49 from diseased plants again brought from Savinia. From 25.1.49 to 31.1.49, six of the plants were wilting and produced typical gum ooze on sectioning.

On 18.2.49, the above experiment was repeated on three young tomato plants each, with six of the isolates used on 19.1.49. Three plants were stabbed through a drop of sterile water as controls. Some of the inoculated plants began wilting on 21.2.49, with the tissues collapsing at the centre of inoculation. The next day, the shrunken tissues had begun to turn brown, whilst the wilting was more intense and three plants had toppled over at one of the inoculated areas. On 7.3.49, fifteen of the inoculated plants were nearly dead and all produced gum ooze on sectioning the stem. Three plants inoculated with one of the isolates were still green, although one was just beginning to wilt. The controls remained healthy.

The inoculation into tomato plants of other isolates from Richelieu in Plaines Wilhems on 24.11.49, from Palmar in Flacq on 24.10.55 and from Ferney in Grand Port on 13.12.56, also resulted in typical symptoms of bacterial wilt.

(f) *Inoculation of the Casuarina pathogen on filao*

On 19.1.49, three young filao plants each, growing in pots, were inoculated with the seven isolates used for the tomato inoculations effected on the same date. The inoculations were made by stabbing several times the stem of the plants with a needle through a drop of suspension of the one-day-old cultures. By 1.3.49, many of the plants had wilted, but it was found in each case that the bark had been eaten off all around the stem just below the ground. On that date, three plants left were wilting ; they also showed the bark damage near the collar, but were nevertheless examined. No gum ooze was observed on cutting the stem, but longitudinal sections of the tissues near the inoculated region showed gum ooze from the end of the vessels when examined in a drop of water under the microscope.

On 29.3.49, two rows of two to three-year-old filao plants which had been planted at the Richelieu allotment area were used for inoculation. Six plants each were inoculated with four isolates of the filao bacterium, ten plants being kept as controls. The plants were inoculated by boring $\frac{1}{8}$-inch holes one to two centimetres deep into the wood at four different levels round the stem with a ratchet hand drill and filling the holes with suspensions of 2-day-old cultures of the isolates. The holes in the control plants were filled with sterile water. No precaution was taken to disinfect the surface of the stem before boring the holes which, at the end of the work were closed by tying a piece of adhesive cellulose tape round the stem ; neither was the drill disinfected before boring the holes.

Up to the 15th. of May following, no symptoms were exhibited by the inoculated trees, after which several of them were showing many needles of the lower branches turning yellow. In the following month of August, one of the inoculated trees was cut, but scanty, doubtful ooze, was produced from several veesels in a portion of stem left overnight in a moist atmosphere. In October next, nine of the inoculated trees and two of the controls were cut at intervals. The stumps of some of the trees showed sometimes numerous, at other times rather scanty milk-white to yellow gum ooze from the cut surface. Brought to the lab, only some of the cut stems showed a few gum drops, but left overnight under wetted gunny bags, deep cream and light-yellow to yellowish brown ooze was produced in greater abundance from six of the stems, but was still scanty in the others. The wood had turned light brown at places, chiefly towards the centre. The wood of the controls was healthy-looking and produced no gum ooze.

Considering that the progress of the disease had appeared to be slow inside the inoculated trees, those remaining in the field were left for examination at a much later date : unfortunately, the land having been needed for other purposes, all the filao trees in the field were unfortunately cut in 1951.

Fortunately, reisolation of the pathogen had been effected when the inoculated trees had been cut and examined in October 1949, and four reisolates which had been obtained were inoculated on 29.10.49 into thirteen young tomato plants, three other plants being kept as controls. The inoculated plants were wilting by 7.11.49 and showing leaf epinasty, browning and collapse of the tissues with production of root primordia about the inoculated regions, typical of *P. solanacearum* infection. On 11.11.49, the wilting plants were cut and the production of gum ooze was observed.

On 15.11.55, inoculations were effected into ten young filao plants in two series of five each, by making a small upward slanting cut into the stem with a sterile scalpel and smearing the wounded surfaces with a heavy suspension of 24-hour-old transfers of two filao isolates obtained from material collected at the Palmar Cattle B.eeding Centre in Flacq district on 6.10.55. Five plants were similarly treated with sterile water as controls. The identity of the two isolates had been ascertained by inoculation into tomato plants.

One of the isolates proved, however, more active than the other in setting up infection. With that isolate, two of the filao plants had wilted on 4.1.56 ; they were cut and showed internal browning of the wood and production of beads of gum from the cut surfaces. One inoculated, but healthy-looking plant, was also cut on that day ; it showed gum ooze under the microscope and produced after some time small gum beads from the cut surface of the stump. By 7.2.56, both remaining inoculated plants had nearly completely dried out ; they showed profuse gum exudation under the microscope.

With the other isolate, one plant showed a slight dull-green appearance on 9.1.56, when on cutting, the wood was observed but very slightly browned. Gum production was produced under the microscope. On 7.3.56, the four plants

left were still healthy-looking. Upon cutting one plant, slight browning of the wood was seen internally and ooze of gum under the microscope was profuse. Numerous gum drops were produced on the cut surface of the stump.

On 18.5.56, that is, six months after the inoculations, the remaining three plants of the series were still apparently healthy and they were all cut. The observations on one of the plants were exactly similar to those shown by the plant cut on 7.3.56. The two other plants, however, showed practically no internal browning ; neither could gum ooze be observed from longitudinal sections of the wood examined in water under the microscope. The control plants were all completely healthy.

This experiment indicates that the reactions shown by even young filao plants following inoculation with *P. solanacearum*, even with the strain from the filao itself, are not always uniform and that the interpretation of the results of such experiments should be made with caution.

The inoculation of young filao plants growing in tins was repeated on 15.11.55, when five plants each were inoculated with two cultures freshly isolated from diseased trees growing at Palmar. These isolates had been proved to be the correct organism by the production of wilt and gum ooze by tomato plants inoculated on 24.10.55.

The inoculations were this time effected by making an upward slanting cut on the stem with a sterile scalpel, the cut, some one-fourth inch long, reaching about half-way across the stem. The cut surfaces were smeared with a heavy suspension of 24-hr.-old transfers of the isolates, using the platinum loop for the smearing ; after which the wounded stem was strengthened by wrapping with cellulose tape. Five plants with sterile water added to the cuts were used as controls.

From January to May 1956, most of the inoculated plants of both series had shown yellowing of the needles, wilting, internal brown discoloration of the wood and production of gum ooze, sometimes profuse, from the cut surface of both stumps and stem sections. In the few cases where gum ooze was not observable to the eye on cutting the plants, longitudinal sections of the stem showed gum exudation from the ends of the vessels upon examination in water under the microscope.

The above experiments had definitely proved that *Pseudomonas solanacearum* (E. F. Sm.) Dowson was a direct cause of disease of filao trees in Mauritius.

(g) *Inoculation of P. solanacearum from tomato on filao*

1 — On 1.3.56, four young filao plants growing in tins were inoculated by making a small upward slanting cut near the base of the stem and smearing the wound with a suspension of two isolates of *P. solanacearum* obtained from

wilting tomato plants, collected one at Bonne Terre in Plaines Wilhems (culture Tom/BT) and the other at Arsenal in Pamplemousses district (culture Tom/Ars).

Up to 5.7.56, no external sign of the disease having been observed the plants were cut, when the following observations were made:

Cult. Tom/BT — One plant, no internal symptom; no ooze under the microscope.

Another plant with a slight browning of the wood for a length of 2" internally; no ooze under the microscope.

Two plants with slight browning and water soaked appearance of the wood near the original cut; ooze produced in water under the microscope.

Cult. Tom/Ars — Browning on the four plants for lengths of from 1" to 5" internally; water soaking of the wood present; ooze visible under the microscope.

2 — On 18.6.56, a tomato plant affected with bacterial wilt at Réduit was used as follows: A root oozing gum in abundance was cut, the cortex removed, and thin, oblique slices of the wood were inserted into slits made at half the height of the stem of five young filao plants growing in tins. In all such inoculations on the filao, the wound was wrapped over with adhesive cellulose tape.

On 12.9.56, all the plants were apparently healthy and three were cut. A small amount of woody tissue was seen dead in the region of the cut, with a reddish-brown discoloration towards the centre of the stem for about ½" above and rather less below the cut. No gum production was visible to the eye, but a weak exudation was observed under the microscope.

On 19.10.56, the two remaining plants, still healthy-looking, were cut. The internal discoloration of the wood was still not extensive; no exudation was observed under the microscope.

(h) *Inoculation of P. solanacearum from eggplant on filao*

1 — On 8.3.56, the stems of four young filao plants growing in the same tin were wounded by making a slight upward slanting cut with a sterile scalpel and smearing the wounds with a suspension of a 24-hr.-old transfer of a culture of *P. solanacearum* newly isolated from a diseased *Solanum melongena* plant collected at Réduit. A fifth filao plant in the same tin was similarly wounded, but not infected.

Up to 5.7.56, no plant was wilting and they were all cut. One plant showed slight internal browning of the wood, but gum ooze was not observed.

Three plants showed intensive internal browning and exuded gum under the microscope. The control showed neither browning nor gum production.

2 — On 13.4.56, thin wedges from another eggplant from Réduit naturally infected with bacterial wilt were prepared from regions oozing gum and inserted into an oblique cut made in the stem of three young filao plants.

On 4.5.56, one plant was drying, the stem above and below the cut having turned black for a short distance from the cut. Gum ooze was visible under the microscope. For comparison, another inoculated plant still apparently healthy was cut. There were no visible lesions internally, but gum ooze from sections removed in the immediate vicinity of the inoculated area was observed under the microscope.

On 19.10.56, the third plant, still apparently healthy, was cut. A brown strand was seen internally for a short distance up and down from the inoculated area. Gum ooze was visible under the microscope.

(i) *Inoculation of P. solanacearum from filao on tobacco*

On 29.10.49, one young tobacco plant each was inoculated at two places at nearly the same level round part of the stem, with four cultures of the filao pathogen. These cultures were 36-hr.-old transfers of the pathogen reisolated four days previously from inoculated filao trees, and the inoculations were made by needle pricks through a drop of the bacterial suspension in sterile water. The reisolates were inoculated on the same date as the tobacco plants on thirteen young tomato plants and resulted in 100% infection after twelve days.

Up to 7.12.49, none of the tobacco plants had shown signs of having picked up infection, but on their being cut and examined on that date, two showed the wood slightly blackened at places in the region of inoculation. No ooze was observed even under the microscope. The two others also showed xylem blackening at places, and minute gum drops were observed upon the cut stem after about half an hour.

(j) — *Inoculation of P. solanacearum from tobacco on filao*

1 — On 15.6.56, thin longitudinal slices of wood were cut from the stem of a tobacco plant collected from an inland area in Flacq district and affected with bacterial wilt. The stem and roots of the plant easily oozed gum on cutting. The prepared slices were inserted into slits made towards the bottom part of the stem of five young filao plants growing in tins.

On 11.9.56, the plants were all apparently healthy ; one was cut and examined, when only a short reddish-brown streak was noticed in the central part of the stem, running upwards for about one centimetre from the wound. Bacterial ooze was observed under the microscope.

On 10.10.56, the remaining plants were cut when the observations were nearly the same as those made on the previous plant.

2 — On 15.6.56 a drop of sterile water was placed on the sectioned surface of a root of the tobacco plant mentioned above. The root was abundantly oozing a dark-coloured gum. The surface of the wood was scraped with a sterile scalpel so as to mix up the gum with the water and get as much inoculum as possible.

Three young filao plants were inoculated by placing a small amount of the suspension on the young part of the stem, about four inches from the tip, and pricking through several times. Two plants were similarly pricked through a drop of sterile water as controls.

On 11.9.56, all the plants were healthy-looking. One of the inoculated plants was cut and showed some browning of the tissues about the pricked area, but no ooze was observed even under the microscope.

On 19.10.56, the two remaining inoculated plants, also apparently healthy, were cut. The observations made were the same as those noted on the last above-mentioned date.

(k) *Inoculation of P. solanacearum from filao on Capsicum*

On 13.3.56, three young *Capsicum annuum* plants were inoculated with a suspension of a 24-hr.-old transfer of a culture of the filao bacterium isolated on 31.10.55. The plants were infected by pulling off a young leaf and smearing the wound on the stem with the suspension, and also by stabbing through a drop of the suspension at two levels on the stem. Two control plants were left untreated.

On 23.7.56, only two of the inoculated plants and the controls remained. All were apparently healthy. Internally, the inoculated plants showed a brown strand running for several inches. Only one of the plants produced ooze of gum under the microscope.

(l) *Remarks on the inoculations made*

The inoculations effected with the filao bacterium on tomato and the cross-inoculations on the filao were necessary to prove the identity of the filao pathogen with *P. solanacearum* ; those concerning tobacco, eggplant and Capsicum were effected with a view to determining whether these plants could not become infected between themselves when planted on the same land.

It is indeed the custom when filao is planted, to allow small planters to grow foodcrops on the land under certain conditions until the filao has reached a certain development. The food crops grown are chiefly tomato, eggplant, chillies and occasionally potato and onion. The following is a summary of the principal inoculations made :

Pathogen		No. of plants		Disease
Origin	Plant inoculated	Inoculated	Infected	Index
Filao	Tomato	44	38	86
Tomato	Filao	9	5	55
Filao	Tobacco	4	2	50
Tobacco	Filao	8	5	62
Eggplant	Filao	7	6	85
Filao	Capsicum	2	1	50

In the absence of wilt symptoms, the criterion for considering that infection had been picked up was the production of gum ooze from cut surfaces, visible either to the naked eye, or from longitudinal sections examined in water under the microscope. The disease index has been calculated as the percentage of plants having taken up infection in that sense, although in a few cases, a larger number of plants should have been inoculated.

Our experiments have indicated that *P. solanacearum* results in a very slow rate of infection upon artificial inoculation into susceptible woody or semi-woody plants. For example, upon inoculation into the tender part of the stem of young, about four to five months old filao plants, with *P. solanacearum* isolated from the filao or from other plants, no wilt resulted even five to six months after the inoculation, although infection had been picked up. This may not in general, however, be the case in nature, inasmuch as filao plants, even only about two years old, have at times been observed in the field, badly infected with the disease. Thus, the tobacco plant which showed no wilt more than one month after the inoculation and the Capsicum plants which showed no external sign of disease four months after having been inoculated, although they had picked up infection, cannot be taken to indicate what the kind of infection, whether acute or mild, would have been following natural infection in the field ; they only point to the plants being, to a certain degree, susceptible to the pathogen. In other words, infection following artificial inoculation of a plant with a pathogen may not always represent the reaction of the plant to the disease under natural conditions.

We must also point out the probability of the existence of different strains of *Pseudomonas solanacearum* in the island, as well also as the fact that different races or varieties of cultivated plants generally show variable reaction to disease in nature.

IV — THE SMUT DISEASE

(a) *General considerations*

The smut diseases, which affect a number of flowering plants, chiefly the cereals and grasses, are caused by fungi belonging to the order Ustilaginales of the Basidiomycetes, the latter constituting an extensive class of Higher Fungi, which also includes the rusts, mushrooms and bracket fungi, for example. The mycelium of the smut fungi aggregates in general at particular points within the tissues of their host and becomes divided up into innumerable thick-walled, dark-coloured spores, which generally rupture the infected tissues and appear outside most often as black powdery mass resembling soot, whence the name of the disease.

The smut disease of filao is not, in that sense, a true smut. Its causative agent does not belong to the Basidiomycetes, but to the miscellaneous group of fungi referred to as the Fungi Imperfecti, imperfect because no method of sexual reproduction, which helps to classify the other fungi, is known about them. The spores of the filao smut fungus are not formed by the division of densely woven hyphae into individual spores but, according to Butler, are produced in clusters by special branches or sporophores. The spores are produced in such immense numbers that blisters develop in the bark of the affected trees, which finally burst, exposing a dense mass of soot-like spores. Hence the name of smut applied by analogy to this disease of the filao.

(b) *The disease in India*

As already mentioned above, the disease was studied on *Casuarina equisetifolia* by E.J. Butler in 1905 in India, who concluded that it was caused by the fungus producing the black spores and which he described under the name of *Trichosporium vesiculosum*. Butler published a report on the disease in the Indian Forester (8), from which we extract the following :

> " The Casuarina plantations on the sand dunes of the East Coast are subject to several diseases..... One, which I saw in the Chatrapur plantations..... in August 1904, is of fungal character..... Amongst the dead trees, of which there were a number in the plantation, some were found with the bark raised up into great blisters, and eventually ruptured by the formation of a black powdery substance consisting of myriads of spores of a fungus.....
>
> " The trees died out in patches..... A parasitic fungus was found within the central wood, which there can be little doubt is the cause of the disease. It is, curiously enough, apparently identical with that first found in the bark..... ..... Why it should sometimes remain internal and sometimes break out on the surface is not clear. In the earlier stages the trees look sound enough, even when the collar is exposed, except that many of the twigs are dead and clusters of withered needles remain attached to them, the whole appea-

rance suggesting water-logging or drought. The extension of the dead patch from which the specimens were taken in a centrifugal manner up a sharp slope of the sand, which is here very deep, and the healthy state of the adjoining trees put these possibilities, however, out of the question.

"The internal fungus..... occupies the centre of the wood, reaching in one or two places to the vicinity of the cortex, but elsewhere separated from the exterior by an inch or more of sound tissue. It is not visible to the naked eye, but in some cases is accompanied by a discolouration of the wood, visible on section..... The wood of many of the lateral roots is also discoloured, and where they enter the tap root their passage through the exterior tissues is sometimes distinctly visible as dark streaks.....

"The destruction of the wood is not considerable. All the contents of the cells invaded by the hyphae are destroyed and a brown residue fills those which have had living contents, such as the parenchyma, giving rise to the discoloured appearance of the diseased tissue sometimes observed. Lignified tissues are but slightly attacked, and there is no change apparent in the walls of the fibres until a late stage. The effect of the fungus on the tree is greater than would appear warranted by the mere destruction of the living contents of the cells, and the physical result of blocking of the vessels with hyphae. It is probable that the death of the trees is largely due to ferment production, or the formation of some poisonous substance thrown into the sap.....

"The bark-rupturing fungus, first observed, produces far more striking effects. The bark is lifted from the cambium along the trunk into great blisters by the formation here of a layer of densely woven hyphæ, which produce spores in such abundance that the black powder composed of them is sometimes a quarter of an inch in depth. Later on these blisters rupture, raising the bark in loose sheets and exposing the spores.....

"The spores are borne on hyphæ of variable length and often branched, each bearing a cluster of spores near its tips on the main axis or on short thick branches of the secondary or tertiary order....."

We must draw attention to the fact that Butler states that "the bark is lifted from the cambium along the trunk in great blisters" and that "later on these blisters rupture, raising the bark in loose sheets". In the diagnostic characters which he gives of the fungus, he again states that the hyphae form "colourless cushions in the cambium" and that "the spores form "a dense layer in the cambium". There seems to be no doubt that the fungus attacking the filao in Mauritius is the same as the Trichosporium found in India, inasmuch as in his report dated 24.1.18 on the diseased specimens sent for examination

by Tempany to Stockdale in Ceylon as mentioned earlier (letter 4120/17 of Dec. 14, 1917), Petch recognized the identity of the two diseases and stated :

> "Specimen 8 bears a black powder between the bark and the wood, which consists of the spores of *Trichosporium vesiculosum* Butler. Specimen 4 (root) also bears a mass of the same spores."

The writer, however, disagrees with Butler in his statement that the spores are formed in the cambium and that the bark is raised in loose sheets by the rupture of the blisters. In reality, the spores are formed in the external regions of the bark, just under the epidermis, not in the cambium layer beneath the bark, and it is the epidermis which ruptures to liberate the spores, not the bark itself. Petch repeats Butler's error when he states that "Specimen 8 bears a black powder between the bark and the wood..." ; the smut disease of filao does not form its spores in that particular region of the tree. We have, however, seen at times the bark of dead filao trees peel off in sheets, leaving the wood bare, but this was observed apparently as a result of stresses set up by climatic changes on trees which had been long dead, not as a result of spore production.

One other remark we have to make is that Butler does not mention having artificially infected the filao with *T. vesiculosum* ; he only states that there can can be little doubt that the parasitic fungus which he found within the central wood is the cause of the disease.

(c) *Symptoms of the disease*

We have seen in our discussion of the bacterial wilt disease caused by *Pseudomonas solanacearum*, that dying filao trees attacked by that aggressive parasite often also show the vesicles of *Trichosporium vesiculosum* on the bark ; in such cases, the fungus cannot be considered other than a secondary parasite. It must therefore be concluded that the presence of the smut pustules (phot. 4) on a dying tree is not in itself a proof that the primary pathogen is the fungus itself. We, however, consider convenient to regard a dying filao tree as affected primarily with *T. vesiculosum*, when smut vesicles are present along the trunk or branches and when the symptoms of the bacterial wilt disease and of Armillaria rot are absent, as well as any other obvious cause which could be held responsible for the death of the tree.

The symptoms of smut disease, taken in that sense, apart from the presence of the vesicles of spores, are not definite. The needles generally fall off gradually. but trees have been seen dying, with a large part of their needles and fruits dried up in situ. The wood in cross-section is generally dark-coloured from the centre to more or less near the periphery, but the outline of the affected part is more regular than, and not as jagged as, in the case of the bacterial disease, although slight indentations may occur at places. The splashes of diseased tissue in the otherwise healthy outer ring of wood, so characteristic of the *Pseudomonas solanacearum* disease, are however absent. Again, the affected wood often occupies an eccentric position within the stem, whereas it is concen-

tric in the case of the bacterial disease. As a result, the dead wood may reach the bark on one side of the tree first, killing that part of the bark, when a black strip running up the trunk results, upon which some time later, smut vesicles are formed. The remainder of the tree may remain healthy for a long time and increase in girth, when the strip becomes more or less depressed. On the healthy part of the bark, tufts of small needles may be formed, as if in an attempt to maintain the life of the tree.

When death of the bark is nearly complete all round, it may show numerous blackened patches corresponding to places where the smut spores are being formed and where vesicles develop. It must be noted that the pustules of spores are also formed on roots in the soil. On opening newly-forming blisters, white masses of spores are found at places, chiefly at the margin of the black spore mass, the smut spores being colourless at first, turning black later.

The colour of the affected wood varies from Drab Gray to Hair Brown ; that of the dead strips of bark is about Fuscous, whilst the colour of sound filao bark in tall trees is about Dark Vinaceous Brown (10).

Dying trees were once observed in which the inner parts of the wood in section, were seen to have but slightly changed colour. A peculiar sour smell suggestive of some fermentation was noticed and a feeble resinous-looking exudation was observed at certain parts of the cut surface. It is doubtful if these symptoms are attributable to the smut disease, although some of the trees were showing the smut vesicles. Dying trees with smut spores present have also been seen in which on cutting, the wood was observed forming a regular, narrow, light-brown ring at the periphery, the remainder of the wood inside the ring appearing healthy.

(d). *Inoculations of smut material on filao*

We have already mentioned that both d'Emmerez and Shepherd stated that experimental infection of filao with the spores of *T. vesiculosum* repeatedly failed. In order to show the importance we attached to the possibility of artificially infecting filao with the smut fungus, we give below a brief account of the experiments which we effected on different occasions in that direction. The inoculated plants according to their size were kept under observation for from about six months to more than a year ; no external sign as to the disease having been picked up was ever observed, but in two cases, a mild internal infection resulted, from which the fungus was recovered in culture, as will be shown lower down.

(i) — *Failures experienced*

11.4.48 — Twelve 2-year-old trees infected by boring a $\frac{1}{8}$" hole into the trunk with a ratchet hand drill and inserting a rice culture of the smut fungus.

19.1.49 — Four tins with two young plants each were infected by mixing smut spores with the surface soil.

29.10.49 — Three plants in tins, infected by wounding the main stem and the lateral branches near the tip and applying a suspension of freshly-collected spores. (The spores were difficult of wetting, but one drop of Shell Teepol was added as spreader to about 1 millilitre of water — treatment previously proved harmless to the growth of the spores).

10.3.51 — (1) Five branches of 2-yr.-old trees wounded by lifting a strip of bark from off the wood and applying smut spores, tying back with cellulose tape.

(2) Twelve branches of the same trees infected by boring a $\frac{1}{8}$" hole, working in smut spores using a small piece of wood as plunger and closing the holes by wrapping with cellulose tape.

25.2.52 — (1) Five plants in tins, inoculated with spores made into a thin paste by mixing in a mortar with a small quantity of water to which some solidified peptone-saccharose agar (Wilbrink's agar) had been added (by that treatment it had been found that the spores could be wetted). A few needles had been plucked off in a zone about $\frac{1}{2}$" long at a distance of 4 to 6 inches from the tip of the stem. The smutted agar was smeared all round the wounded stem ; afterwards, melted peptone-saccharose agar which had been cooled down to about 45°C. was smeared over the smut jelly with a brush, with a view to stimulate germination of the spores. The whole was wrapped over with a small wad of cotton wool wetted with sterile water ; cellulose tape was rolled over the wool to help maintaining humidity about the spores.

(2) Similar treatment to 9 plants, using peptone-saccharose agar permeated with smut mycelium from culture tubes, instead of the smutted agar jelly.

31.5.54 — Prepared a number of wedges of young filao wood about $\frac{3}{8}$" long by $\frac{1}{8}$" at the thickest part. Sterilized in the autoclave and pricked the wedges into solidified agar medium in Petri dishes. Inoculated the agar at a number of places with mycelium from culture tubes of smut spores. After one week, the wedges were used to infect young branches of 2-yr.-old filao plants. They were found to be difficult of insertion into the wood of the branches ; in consequence, a split was made in the bark of these branches, the bark was lifted from off the wood and the infected wedge was inserted beneath the bark. The wound was sealed over with grafting wax. Fifteen inoculations were made.

(ii) *Apparently successful inoculations*

(1) On 25.2.56, a light upward cut was made into the stem of three young filao plants growing in pots. The wound was smeared with fresh smut spores made into a paste with peptone-saccharose agar as already explained and wrapped over with cellulose tape.

The three plants, which were all apparently healthy, were cut on 7.9.56. Very little brownish-red discoloration of the wood just about the inoculated zone was observed. From two of the plants, four cultures were made of the discoloured wood just beyond the inoculated area.

On 18.9.56, two cultures were showing a white, rather mealy fungus growth typical of *T. vesiculosum;* the other two tubes were contaminated with bacteria. Transfers were made of the fungus isolates, to compare with transfers of the smut fungus made simultaneously (*T. vesiculosum* was not observed to produce spores in the laboratory on the medium used).

On 10.10.56, the cultures were compared and the reisolates from the inoculated filao trees were considered typical of *T. vesiculosum.*

(2) On 1.3.56, six plants in pots were inoculated by inserting under the bark small wedges of filao wood which had been placed on 25.2.56 in Petri dishes, as already explained, on medium inoculated with mycelium from smut spore cultures.

On 7.9.56, all the plants were looking perfectly healthy, and one plant was cut. A light brownish-red strand less than half inch long was observed towards the centre of the stem, both above and below the inoculated area. Four cultures were made of tissue well beyond the inoculated zone, after ordinary disinfection of the material as usual.

On 18.9.56, transfers were made of three cultures which had produced a white mealy growth and transfers were simultaneously made of a culture of the smut fungus for comparison.

On 10.10.56, all three isolates from the inoculated trees were found exactly like the control smut cultures.

(iii) *Observations on the above*

The last two experiments reported above appear to show that *T. vesiculosum* can be made to infect healthy filao trees artificially, although the progress of the resulting disease is excessively slow. In trees weakened through other causes, the development of the disease might, however, be more rapid. Two possibilities exist here : Firstly, the infection set up could have slowly progressed over a number of years, increasing perhaps in intensity meanwhile and finally bringing about the death of the plant or, secondly, the mild infection which had resulted could have died out with time, the inoculated plants ultimately recovering from the attack.

In the first case, the meaning would be that the trials at inoculation reported above as having been negative, as also those effected in the past by d'Emmerez and Shepherd, could perhaps have been found to be positive had the observations been continued over a sufficiently long period, when *T. vesiculosum* would have had to be classed as a primary agent of disease on the filao, albeit a slow-acting pathogen, which could give opportunity for saprophytes or secondary parasites to help in the attack and precipitate the death of the plant. In the second case, *T. vesiculosum* could not be considered other than a secondary parasite attacking filao trees only when they have been weakened through other causes. On the whole, the chances are that *T. vesiculosum* is not a very active direct agent of destruction of *Casuarina equisetifolia.*

V — ARMILLARIA ROT

On 4.9.50, a small filao plantation in a clearing by the side of Plaines Wilhems river, near the railway bridge at Rose-Hill, was observed in which some twenty-five about 2-year-old trees were dead or dying. Examination showed that the plants had been attacked by the root disease fungus *Armillaria mellea* (Fr.) Quél. The disease had also been observed in the month of June preceding, on a few 3 to 4-year-old plants in a row near the labourers' camp at Réduit (6). It was again seen on a few trees in a tall plantation at Montagne Ory in Moka district.

The first outward symptom exhibited by affected young trees is a bright-yellow discoloration of the needles (Cadmium Yellow to Capucine Yellow (10)), gradually working from below upwards, coupled with a blackening of the bark from below the ground up the trunk. Beneath the dead bark a dense plate of white, feathery mycelium is present, which causes the drying bark to crack in longitudinal fissures, through which black xylostromatic strands of the fungus mycelium may be seen.

The yellowing of the needles was not observed in the case of tall trees attacked by the disease, but as the latter progresses on the plant, whether young or old, the needles gradually dry up and fall off in large part. The attack on the wood is of the nature of a dry rot. Neither sporophores of the fungus, nor rhizomorphs were seen.

VI — MINOR DISEASES

(a) *Scaly bark disease*

A disease which is but occasionally encountered is characterized by an excessively thick, roughened, scaly bark (phot. 10), which gives to the stem an appearance quite unlike that of the normal filao plant. The scaliness is sometimes so pronounced that it suggests the scales of a small-sized dry pine cone at places. The top part of the plant and the ends of the branches die first, followed much later by the death of the tree. The disease, I have been told, is sometimes referred to as "filao mozambique" by the fishermen of the coastal villages.

The larger part of the needles slowly drop off, but many of the dormant buds of the branches, or of the adventitious buds formed, develop profuse witches' brooms from small gall-like swellings of the stem, or from thickened shoots only a few millimetres or centimetres long. Many of the shoots forming the witches' broom's may develop a fasciation of the stem.

The whole bark, from the bottom of the tree to varying heights upwards, is split up into innumerable warty islets separated from one another by large gaps, resulting apparently from excessive production of criss-crossing strips of cork cambium originating in the outer regions of the stem. Higher up, the patches of diseased bark may alternate with healthy-looking parts of the stem or

branches, the disease being thus seen to start from individual cankers which finally become confluent. Branches more or less completely encircled by the disease are sometimes seen of larger diameter than the immediately succeeding apparently healthy part.

The wood of the witches' brooms show light brown patches and small cavities internally. The holes and the discoloration extend up into the main branch of the witches' brooms and also down inside the branch constituting their primary, but not to any great depth within the latter.

Fungi were obtained in culture, but no investigations were carried out with them.

(b) *Bark-cracking disease*

The most conspicuous symptom of the disease, which ends in a slow death of the plant, is a profuse, irregular cracking of the bark from the collar upwards, the fissures remaining of small width, with the result that the bark islets formed remain more or less in close contact with one another (phot. 9). High up along the smaller branches, where the splitting is not yet evident, the bark is roughened by small raised, dark-coloured, pustule-like patches, a stage of the disease which evidently precedes the cracking.

The intumescences vary from pin-head or less to more than one centimetre in size and often completely encircle the branch. They are circular when small looking then like pimples under a low power lens, but they grow into patches of irregular size, often by fusion of individual pustules. A canker was found on the branch of a diseased tree, which had encircled the branch completely, the attacked part having become of larger diameter than the branch itself, giving a fusiform appearance to that part. The swellings are about Warm Blackish-Brown, whereas the normal young filao bark is about Vinaceous-Brown or Cameo-Brown in colour.

On slicing off successive thin strips of the bark of the affected patches, the upper layers of tissue are seen to be dead ; a little lower down, the bark is of an irregular reddish-brown colour, with numerous darker specks present ; layers still somewhat deeper fade into a pinkish discoloration. The pustules may be compared to cankers of the swollen type in which the infection does not readily reach the cambium.

The following investigations were carried out on the disease. After disinfection of young diseased branches with alcohol and flaming, the pustules were sliced off with a sterile scalpel and portions of the reddish-brown middle layers were transferred to culture tubes. Cultures were also made of portions from the still apparently healthy lower layers of the bark in contact with the discoloured regions, as well as of slightly darkened outer wood beneath the patches. Sixteen cultures on the whole were made, but only three of them developed fungi, apparently different from one another, one of them being a Pestalotia.

A portion of young stem with the bark roughened with the disease was disinfected and placed in a moist chamber. A growth of Rhizopus developed in two days on both the bark and wood surfaces and a few Pestalotia spores were also observed.

Inoculations were made into young filao plants growing in tins, using (a) diseased bark material crushed with water in a mortar and (b) mycelium of the fungi obtained in the culture made, but no infection resulted.

(c) *Bark-splitting disease*

At Chamarel in May 1952, a seven-year-old filao plantation was seen in which a large number of trees were showing longitudinal splits of the bark (phot. 13). The following description is taken from the notes written down at the time: "The disease starts as narrow longitudinal slits of varying lengths; some are only a few inches long, but others may reach a length of several feet. The bark lifts off from the wood on both sides of the split, so that with time, the two lips project dome-like on the outside and, with increasing girth of the tree, gape widely apart.

A secondary cortex forms on the surface of the exposed wood, which latter may reach several inches in width. In the new cortex, which remains thin, chlorenchyma develops.

In the centre of the exposed region and apparently corresponding to the position of the initial split, longitudinal markings are seen, irregularly roughened into various shapes by callus tissue apparently closing in on the initially exposed wood. Where patches of the latter exist which have not yet healed over, the wood is dead just at the surface, suggesting that the cambium is killed in a rather narrow band at the time of formation of the split.

The bark, when cut, exudes sap easily. On one tree, two large gaping splits, each three to four feet long, were seen on opposite sides of the tree; other cases were seen with three or four slits in succession up the stem."

The disease was taken to be related to warm, humid conditions following a period of drought, but later trees showing similar longitudinal splits of the bark were observed at Pointe aux Canonniers, a dry region in the north of the island.

(d) *Witches' broom disease*

In spite of the fact that in certain other diseases of the filao, for example in bark-cracking and scaly-bark diseases, small witches' broom tufts develop along the stem and branches, the name witches' broom is given to the disease under consideration here because in the former the witches' brooms are not very conspicuous and other more striking symptoms characterize the diseases.

In the disease here referred to, which is occasionally encountered in

PLATE III

Phot. 9 — Bark cracking disease.
Specimen from Bel Air S.E. Photographed 7.2.52

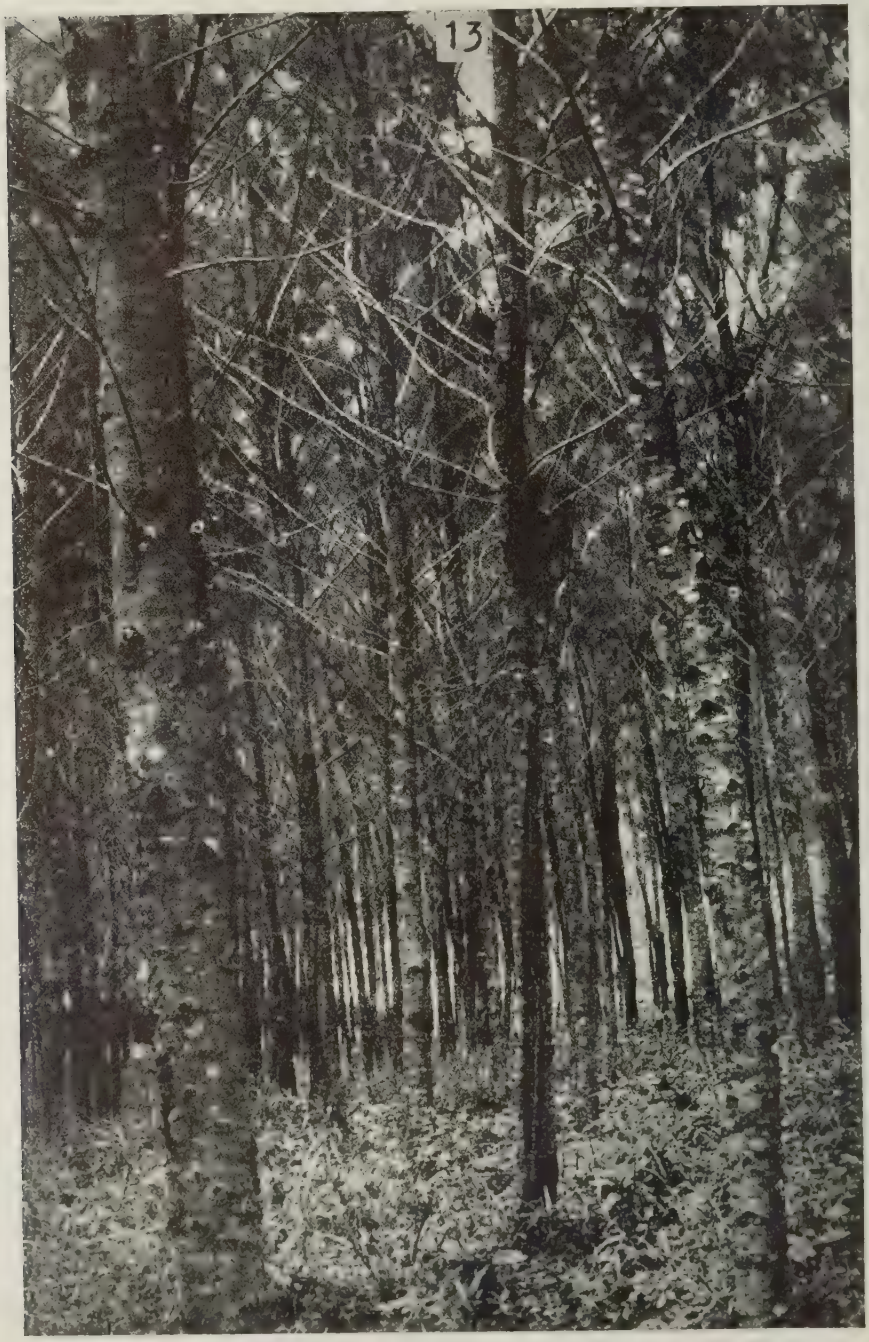
Phot. 10 — Scaly bark disease.
Specimen from Case Noyale in Black River. Photographed 20.5.52

Phot. 11 — Tree in centre showing witches' broom aspect.
Photographed at Case Noyale on 23.11.52

Phot. 12 — Extreme case of fasciation on filao. Photographed Nov. 52

PLATE IV

Phot. 13 — Bark splitting disease. Plantation at Chamarel, photographed 27.5.52
The tree in centre foreground shows a series of three long splits, the topmost one being still in the early stages of formation.



plantations, the stem and branches are densely clothed with thick tufts of small witches' brooms, without any other visible symptom of disease being present (phot. 11), save a die-back of the top of the main stem and of its upper lateral branches. Such diseased trees are nearly always of smaller height than surrounding trees.

The diseased trees often have a general pronounced yellow appearance, owing to the fact that yellow-discoloured segments alternate with normal-green joints along the individual needles. It is not certain, however, that this particular yellowing is not due to a different affection, as trees affected with the witches' broom disease as here described, are sometimes seen of normal green colour, without any discolouration along the needles. The appearance of what we may call the yellow-needle disease, suggests roughly a virus affection, or the effect of a genetic cause. A deficiency disease seems excluded, as surrounding trees in a plantation show no sign of being affected.

(e) *Seed spotting*

A black spotting of filao seed associated with a species of Pestalotiopsis (letter Commonwealth Mycological Institute No. 2453/50/1-Maur.) was occasionally observed. The fungus is apparently harmless to filao.

VII — PHYTOPHTHORA ON FILAO

Several of the filao trees inoculated with a number of bacterial isolates at Richelieu on 29.3.49, as already mentioned, showed a few months later irregular, black discoloration of the bark in longitudinal strips from the base upwards, along a varying length of the trunk (6).

On 25.10.49, the trunk of one of the trees which had been brought to the laboratory was disinfected with methylated spirit followed by flaming. The external layers of the bark, towards the upper end of a dead strip, were trimmed off with a sterile knife and portions of the inner bark were removed from newly-affected regions and cultures made. Similar portions of the dead wood beneath the bark were aseptically removed and cultures also made.

On 3.11.49, seven of the cultures had produced a white mycelium which, upon examination, was seen to belong to a Phycomycete. By that time, eleven other cultures had produced a mycelium, white at first, turning later to greenish-black and to black, a rather frequent occurrence with cultures of such tissue.

The original portion of bark cultured was removed from three of the Phycomycete slants and water cultures made. On 7.11.49, Phytophthora sporangia and swarmspores were observed in the cultures. Sometimes the sporangial hypha was observed to have pushed through an empty sporangium. Transfers of hyphal tips were made from the agar cultures, and on 8.4.50 a specimen culture was forwarded to the Commonwealth Mycological Institute, where it was identified as *Phytophthora cambivora* (Petri) Buisman, " a first record for Mauritius, *Casuarina equisetifolia* being a new host of the fungus " (letter from C.M.I., dated 18th May, 1950).

Inoculation of the Phytophthora into filao

On 28.11.49, seven two to three-year-old filao trees growing at Richelieu Experimental Station were inoculated with rice cultures of the Phytophthora forced into three $\frac{1}{8}$" holes each, bored $\frac{1}{2}$-inch deep at 5-6 inches interval from middle height of the trees upwards. The holes were then protected by winding adhesive cellulose tape round the stem at the inoculated centres. One tree, with holes similarly bored and protetced was kept as control.

On 18.1.50, a light reddish-brown discoloration of the bark was observed around the inoculated centres, accompanied by a shrinkage of the affected tissues. One tree was cut and the wood inside was discoloured dark brown for about $\frac{1}{4}$-inch around the punctures and light brown up to about $\frac{3}{4}$-inch all round beyond. Brown lines sometimes ran longitudinally for several inches from the punctures.

Water cultures and agar slants were made with portions of the affected wood regions, but in spite of all efforts, the Phytophthora could not be recovered. The remainder of the inoculated trees were kept under observation up to December 1950, but showed no other sign of disease. Occasional attempts made later to isolate the Phytophthora from the blackened strips on the bark of diseased filao trees failed.

VIII — SUMMARY

Disease causing death of the filao tree, *Casuarina equisetifolia* Forst., was first officially reported in Mauritius in 1917, and one form, characterized by the production of an abundant mass of sooty spores in the bark, and hence termed smut disease, was associated with the fungus *Trichosporium vesiculosum*, discovered by Butler in India in 1905.

2. Inoculation experiments carried out in the past to prove the parasitic nature of the fungus on Casuarina failed and the presence of *T. vesiculosum* on dead and dying filao trees in the island came to be regarded as purely secondary in nature. The factor primarily responsible for the death of the trees remained undetermined for more than a quarter of a century.

3. In studies carried out in 1948 and subsequently, the writer proved that *Pseudomonas solanacearum* (Smith) Dawson, the bacterium causing the wilt of solanaceous plants chiefly, was the chief factor causing the death of Casuarina trees in Mauritius. The symptoms of the disease are described and a detailed account is given of the inoculation experiments effected.

4. The so-called smut disease is also described and an account is given of the numerous unsuccessful attempts made to infect Casuarina artificially with the smut fungus. The writer finally found, however, that young filao plants could pick up a mild infection upon inoculation of the fiungus into wounds made in the stem. It is therefore possible that *T. vesiculosum* may, under certain conditions, be able to act as a primary cause of disease on filao ; the fungus, however, appears in general to be only saprophytic, or but weakly parasitic in nature.

5. During the researches made, it was found that the fungus *Armillaria mellea* (Fr.) Quél. also occasionally causes death of filao trees in the island. A few minor diseases of the plant, all of occasional occurrence only, are also mentioned.

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RESULTS OF WORK DONE ON THE PRODUCTION AND CONSERVATION OF FODDER CROPS*

by
W. A. WRIGHT
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It is always a matter of surprise to the stranger to Mauritius that the island supports a considerable cattle population. In the first place the animals are rarely to be seen as they are in the main confined to their sheds continuously and secondly there are no obvious areas of pasture to provide the keep of a numerous cattle population. It may not lessen the visitors' surprise to learn that the fodder is obtained very largely from the naturally occurring vegetation of roadside verges and waste places and from the grass growing under the filao trees on the *Pas Géometriques*, as well as from cane tops during the cane harvesting season.

This system is full of weaknesses and the Department of Agriculture has been trying to improve it.

The naturally occurring grasses are not very productive nor is the fodder produced of good nutritive value. The valuable part of grass is the leaf. Most of the local grasses consist of very little leaf and much fibrous stem, which fills the cattle but does not nourish them. So a considerable number of recognised tropical and sub-tropical pasture grasses have recently been introduced from abroad and these have been tried out in Mauritius. The sources of material have ranged from Fiji to the West Indies; many of them have come from different parts of Africa.

The method of testing these grasses has been to grow them in observation plots, recording the weight of grass produced and analysing each promising one mainly with an eye to the content of protein. Other things too must be taken into account, for example, freedom from disease, ability to produce viable seeds under local conditions so that in future new pastures can be cheaply and easily established, freedom from habits of growth which might turn the grass into another troublesome weed, and other points of this nature.

An important matter in testing these introduced grasses is that they require to be tested in the different climatic zones. A grass which will do well in the cool wet region of Curepipe is not likely to succeed so well on the low lying, dry areas of the coast or even in a medium climate like Réduit. Our method has been to establish all the introduced species

*Broadcast by the M.B.S. on 4.11.60.

in observation plots at Réduit and then to put those which, from common knowledge, appear best adapted to the conditions at centres like Curepipe, Richelieu and Palmar. Likewise, grasses are adapted better to some soils than others and this aspect has been kept in mind in our testing programme.

As a result of this work some very useful information has been obtained. We have found for the first time grasses which remain productive during the winter at Curepipe ; previously good growth was obtained in this region during summer from the grass, *Setaria sphacelata*, but it remained dormant for the cooler half of the year. Not only do the newly established grasses like Endebess Rhodes grass remain productive in winter, but they also promise to compare with Setaria for summer growth as well, and they promise to surpass Setaria in quality. Some of these grasses have other advantages such as ease of establishment or ease of maintenance. The most promising of the grasses at Curepipe are Kikuyu grass, Pangola grass and, as already mentioned, the Endebess strain of Rhodes Grass.

At the other extreme at Richelieu and Palmar, other species have shown up well. Perhaps the most interesting grass in these regions of comparative heat and drought is a particular strain of *Panicum maximum*, known as the Sigor strain. This grass has come to us from Africa where it was adapted to a harsh climate. In our trials it has shown itself to be highly productive, of good nutritive value and remarkably drought resistant. It is also an easily established grass. Another better known grass well adapted to the lower hotter areas of Mauritius is Elephant Grass, also of African origin. This grass is not a new introduction, but the interesting thing here is that a selection made from this grass a few years ago, is proving itself much superior in productivity to the average of the crop so that this grass is now a much more attractive species from the farmers' point of view. The best grass of all not only for the coastal climate at Palmar but also for the rough soils of that area may prove to be yet a third African grass known as African Fontail, which has come to Mauritius via the Pasture Research Stations of Queensland.

Finally, another good grass which promises well in the coastal areas is Pangola. This grass is generally the most promising of all our introductions ; it has a remarkable range within which it grows well and seems to be adapted to nearly all the different zones. We have much hope for its future in Mauritius.

Another matter of importance is making the most of the abundant crop of cane tops which at the cane harvesting season provide a readily available bulk of fodder of fair nutritive value. The most obvious improvement to seek is the extension of the period each year when cane tops can be utilised. To this end the Department has been carrying out silage trials with cane tops so that the fodder can be conserved from harvest time for use at other times of the year, especially during those periods when production from other sources is least, because of drought

or winter dormancy. The actual making of the cane top silage has been reduced to a fairly simple and reliable routine; our main efforts this past year have been devoted to the adaptation of silage making to the village cow-keeper. Cheaply constructed pits haved been made in a number of villages and a demonstration has been given of filling such silos. We hope that when the result of these demonstrations are seen, the value of silage will be widely appreciated and individuals will be willing to undertake the extra effort necessary at cane harvest time to secure a reliable supply of fodder throughout the year. It is this question of individual effort which is the key to success for a method which can bring very considerable benefit to Mauritius and which the Department of Agriculture has proved to be straightforward and reliable.

A weakness with cane top fodder, either green or conserved as silage, is that it is lower in protein than is desirable. In order to try to improve matters experiments have been initiated in adding urea to the cane top silage. The rather involved theory behind the utilisation of the urea by cattle to get a more balanced ration, need not be entered into here. Suffice it to say that this line of work promises well in its early stages and we hope to be able to report further success in 1961.

In any report of the work of the Department of Agriculture on improving fodder, the question of protein content of the feed must keep cropping up. Yet another aspect of this is the work being done with legumes, which are rich in protein. It is impossible in this short note to cover this subject but by way of illustration it might be worth referring to one particular point of interest.

A significant and partly unlooked for result of the Department's work on the fodder problem in 1960 has been the growth exhibited by a clover at Curepipe. The species concerned is a rather rare type known to the botanist as *Trifolium ruepelleanum* and to the few agriculturists who have used it as Ruepell's clover. This clover is growing with remarkable vigour at Curepipe and its root is covered with robust nodules, stained a bright shade of pink inside. This clover is not only going to improve the protein content of any pasture in which it is established, but it is also, as the bright pink colour of the nodules indicates, obviously fixing a great deal of nitrogen for eventual utilisation in the soil. Those who know how short the highland soils are in this element will recognise how valuable a thing this Ruepell's clover may eventually prove to be.

Finally, in regard to grazing trials, we have managed by the simple expedient of grazing the animals during the hours of darkness to avoid the biting stag flies *Stomoxys* at Curepipe and thus for a year the animals have flourished in that region without having had any fodder other than the grass they grazed outside. We do not claim that this demonstration is going to cause any immediate revolution in cowkeeping, but it is the sort of basic knowledge one must acquire and which, who knows, may have very practical results in the long run.

REVUE DES PUBLICATIONS TECHNIQUES

P. GOARIN — **Notes sur le lessivage des herbicides par des pluies tropicales.** *Agron. Trop.* 1960 **15** : 450-54.

L'auteur donne un compte-rendu des essais mis en place à la Station Agronomique de l'Alaotra pour tenter de préciser l'interaction produit-lessivage dans des rizières d'alluvions fluviales. Les produits utilisés au cours de cette expérimentation furent les esters butylglycol, alkylcyclohexanol et le sel de soude du 2,4-D et l'ester alkylcyclohexanol du M.C.P.A. La flore d'adventices représentée sur la parcelle expérimentale se composait essentiellement de graminées et de cypéracées. Des résultats obtenus l'auteur conclut que quelles que soient la chute de pluie et la nature de l'herbicide, il y a toujours lessivage et diminution d'efficacité. Il ressort aussi de cette étude que cette diminution est proportionelle à l'importance de la chute de pluie et au nombre d'heures qui séparent le traitement de la pluie. De plus la quantité de pluie tombée joue d'une manière très importante lorsque cet intervalle est égal ou inférieur à six heures. Des herbicides utilisés les sels de soude du 2,4-D se montrèrent peu efficaces car si 60 mm. de pluie tombent huit heures après le traitement les résultats sont compromis. Les esters butylglycol par contre se montrèrent très efficaces : d'excellents résultats furent aussi obtenus avec l'ester alkylcyclohexanol du M.C.P.A.

E.R.

FLOYD, M. ASHTON — **Soil factors affecting the effectiveness of pre-emergence herbicides.** *Proc. 12th Ann. Calif. Weed Conf.* 1960, 109-111.

Results of experiments carried out on the movement of herbicides in soil under furrow irrigation are discussed. The problem was investigated by the study of the movement of dyes and radio-active herbicides (triazine compounds) on filter paper under assimilated furrow conditions. These studies indicated that when the herbicide is applied to the surface and subsequently a furrow irrigation is made, the chemical remains on the surface but moves laterally. On the other hand, when it was incorporated below the surface it moved laterally and downward. Very little correlation was found between the solubility of the herbicide and the degree or extent of movement. The solubility of the herbicides under test varies from 5 to 70 p.p.m. — greenhouse studies also substantiated these findings.

Another aspect of the problem which received attention by the author was the depth of incorporation as a dilution factor. Data obtained showed that depth of incorporation is a critical factor in evaluating the effectiveness of these herbicides. It was found that the deeper the incor-

poration or the lower the concentration of the herbicide in the soil, the less effective was the herbicide. The author concludes in saying that pre-emergence herbicides are not effective under furrow irrigation owing to the fact that these herbicides remain on the surface of the soil and do not come in close proximity of the germinating weed seeds. He also suggests that for soil incorporated herbicides, the rate of application should include the depth factor and be expressed as pounds per acre-inch rather than the accepted units of pounds per acre which do not take into account the critical factor of depth.

E.R.

HENDERSON, M.T.— **Breeding in sugarcane with special reference to kinds of material.** Paper for the meeting of the *American Soc. of Sug. Tech.* at Thibodaux, Louisiana, on 2nd June, 1960.

A fact of significance in the breeding of sugarcane is that the noble varieties being all derived from the species Saccharum officinarum, vary little in form from each other. As late as 1920 the whole world production of sugarcane was based on 8 to 10 varieties of one species. This is probably due to the ease with which sugar cane undergoes vegetative propagation. In modern breeding of sugarcane, parent material is much more varied. Next to the species Saccharum officinarum four others are known ; S. barberi, S. sinense, S. spontaneum and S. robustum ; these four are wild and have no commercial value. However, after the first attempts in Java, their value as parents was soon proved and after the first success, P.O.J. 2878, many breeding stations tried this method to produce varieties for their country. The procedure of crossing a wild form with a " noble " cane, and back crossing the offspring again with the noble parent is called " nobilisation ". The importance of this procedure is accepted all over the world and the search for wild varieties in the country of origin of sugarcane is a practice of many breeding stations.

Until now only a few forms of 2 wild species have been used in the crossings done in the various sugar producing areas. The writer thinks that other wild forms of the genus Saccharum could be used as breeding canes and research in the field of evaluating the worth of other wild forms would be worthwhile.

W. de G.

LAUNDEN, L. L. — **In the field.** *Sug. Bull. N. Orleans.* 1960. **39** : 4.

In his weekly article the writer gives his views on the work of the plant breeding institutes and the benefit from this work for the growers in Louisiana.

The recent spread of mosaic disease in several commercial varieties

has reawakened the interest in the breeding programme. The scientists of the various stations devoted a great part of their time to the problem along two main lines of research : namely the control of the disease in existing varieties and breeding new resistant ones. To this end, production of seedlings has been tripled in the last three years and more wild blood is being introduced in the crossing programme. (This is to try to get resistance from the wild forms into the commercial forms). Many new crosses are made and by means of modern equipment more can be done to have the highest efficiency in the work.

However, it must be borne in mind that new varieties are not bred and selected overnight. This work requires many years of thorough testing, and the development of each new and better variety makes the job of developing the next one more difficult.

W. de G.

FORBES, I. L. AND LING, K. C. — **Particles associated with the ratoon stunting disease of sugarcane.** *Sug. J.* 1960. **23** : 15.

Under the electron microscope, definite particles were seen in the juice of sugar cane plants infected with ratoon stunting disease. Such particles were absent from the juice of healthy plants of the same variety.

The samples for study were prepared by forcing a drop of juice out of the cut end of a leaf on to a collodion membrane on a microscope grid. After air-drying, when examined under both the R. C. A, and the Phillipe electron microscopes, spheroidal particles, fairly uniform in size, averaging 31.9 *mu* in diameter, when compared with measurements of tobacco mosaic virus particles, were seen in material prepared from diseased plants.

As the particles approximate in size several spherical viruses, it is suggested that they are the virus particles of ratoon stunting disease of sugar cane.

An electron photograph of the particles shadowcast with 80% platinum and 20% palladium is given.

R.A.

DOWSON, W. J. and HAYWARD, A. C. — **The bacterial mottle pathogen of Queensland sugar cane.** *I. S. J.* 1960. **62** : 275.

Recently discovered in Queensland, bacterial mottle of the sugar cane was described by Steindl and the organism tentatively identified as an *Erwinia*-like pathogen.

At Cambridge the pathogen was found to be closely similar to *Pectobacterium carotovorum* var. *atrosepticum* and the organism was referred to under that name in the 58th Annual Report of the Bureau of Sugar Experiment Stations, Queensland.

Another discovery by the Bureau was that the disease occurred naturally on *Pennisetum purpureum*, *Panicum maximum* and *Brachiaria mutica* and that the organism could be successfully inoculated into *Sorghum sudanense* and *Zea mays*.

Considering that the pathogen has most of the biochemical characters of *Pectobacterium carotovorum* (Jones) Dowson and that it will infect various grasses, the authors consider it to be a variety for which they have proposed the name of *Pectobacterium carotovorum* var. *graminarum*.

A detailed description of the organism follows.

R.A.

WILLIAMS, J. R.— **Studies on the nematode soil fauna of sugar-cane fields in Mauritius. 4. Tylenchoidea (Partim).** *Maur. Sug. Ind. Res. Inst., Occasional Paper* No. 4, 1960. 30.

This paper records Tylenchoid nematodes which were collected in or around sugar cane roots in Mauritius. Fifteen species are described and brief comments upon their abundance and distribution are appended.

J.R.W.

WILLIAMS, J. R. — **The control of the black sage (Cordia macrostachya) in Mauritius. The introduction, biology, and bionomics of a species of Eurytoma (Hymenoptera, Chalcidoidea).** *Bull, Ent. Res.* 1960. **51** : 123-133. (With appendix by P. O. Wiehe).

The Black Sage or « *Herbe Condé* » formerly a major weed in Mauritius, has now virtually disappeared owing to its suppression by two insect species which were introduced from Trinidad. The first of these insects, *Schematiza cordiae*, was introduced in 1948 and the second, *Eurytoma* sp , in 1949. The biology of *Eurytoma*, the way in which it destroys the seeds of *Herbe Condé*, and the circumstances of its introduction and spread in Mauritius are described. In the appendix, P. O. Wiehe briefly discusses the present ecological status of the plant.

J.R.W.

SMART, S. G. AND CARR-BROWN, K. G. — **Sugar extraction using a screw press.** *I.S.J.* 1959. **61** : 205-206.

A screw press manufactured by Messrs. Rose, Downs and Thompson Ltd. was tried in a South African factory for de-watering final mill bagasse. In the machine, which is driven by a 50 HP motor, the bagasse is de-watered by pressing in a reducing-pitch screw rotating inside a cylindrical cage in which there are perforations for escape of the juice.

Although the tests have indicated that modifications must be made to the machine in order to increase its efficiency, yet during the trials the moisture content of the bagasse could be reduced from 51 to 43 per cent. while pol. per cent. bagasse, which was about 2.0 per cent., was cut down to about 1.6 per cent. The extracted juice purities were high, averaging about 78. When some water was added to the bagasse before feeding the latter to the screw press, pol. in bagasse could be further decreased without increasing the moisture content of the final product. The authors estimate that, on the basis of the above figures, an increase in milling extraction of 1.5 — 2.0 per cent. was obtained. However, with further modifications to the press this figure could be improved upon.

Although the authors advocate that initially a screw press could be added to an existing milling train with beneficial results, they anticipate that presses could progressively replace conventional milling plants with the following advantages saving in capital expenditure, lower power consumption, higher sucrose extraction and production of bagasse of higher sucrose extraction and production of bagasse of higher calorific value.

J. D. de R

BURR, G. O., SLOANE, G. E. AND FURMIDGE, G. T. — **The use of gamma radiation in the weighing of bagasse** *Hawaii Plant Rec.* 1960. **55** : 275-283.

As early as 1954 the authors started investigating the possibility of using gamma radiation for weighing raw sugar and bagasse with the object of developing an accurate, stable and relatively maintenance-free weighing system which, in addition, would use a low-level radiation source so as to safeguard factory personnel from radiation.

These studies have led to the development of a successful bagasse weighing system with an overall accuracy of ± 0.7 per cent. of average bagasse flow rate. This accuracy may not be as high as that of a belt weigher, but the difference is not of practical importance in most industrial applications.

The gamma radiation system offers the advantage over conventional weighing machines in that the weighing element has no moving parts and is cheaper as it can be installed on existing bagasse conveyors.

J. D. de R.

LABIOSA, R. — **Eight years with the rubber belt intermediate carrier.** *Sug. J.* 1960. **23** : 13-14.

In 1952 Central Plata sugar factory, Puerto Rico, installed a Farrel-Birmingham rubber belt to replace one of the conventional intermediate carriers of its 66" milling tandem. The belt, of a total length of 17 feet—

centre distance between head and tail drums being 6'5" — has three plies with 5/8" high friction lugs on the carrying side and a centering lug on the underside. With rubber coverings of 1/16" and 1/32" on the carrying side and underside, respectively, the belt was in operation for six crops ; it eventually suffered slight wear but never caused a single minute stoppage due to mechanical failure and is still carried as a spare.

Successive units purchased have rubber coverings of 1/8" on the carrying side and have not yet shown any appreciable wear. They have been used successfully between any two mills of the tandem and have proved their superiority over conventional slat carriers.

J. D. de R.

BOURNE, B. A. AND FRANCIS, P. S. — **Evaporator cleaning techniques. Suggestions for a new clarification procedure for bad scaling.** *Sug J.*, 1960. **22**: (9), 17-20.

The following is an improvement of a previous technique for cleaning evaporator tubes in the Florida Everglades where bad scaling had occurred.

The evaporator tubes are treated with dilute HCl at room temperature. Foaming is kept down by the use of Nalco 71 — D5, a cheap, noncorrosive defoamer, at the rate of 50 ppm. This eliminates the necessity of using mechanical or air circulation of the acid, for laboratory tests have proved that copper corrosion is about 5 times greater when air is bubbled through the tubes than when no air is used.

The authors also have certain suggestions to make concerning changes in juice clarification to reduce scaling. Various major changes were tried out over a number of years. For instance, one procedure involved the addition of P_2O_5 as triple superphosphate (150-200 ppm) followed by sodium aluminate (20 ppm) and adjusting the pH to 7.7-7.9 with ammonia before heating to the boil and allowing to settle. Sodium aluminate was omitted in certain cases, but, even then, all treatments receiving ammonia gave better results than the usual phosphoric acid/lime clarification. In other words clarified juice from the standard procedure had the highest calcium content.

Actual pilot plant trials confirmed the laboratory results obtained. The calcium content of clarified juice was less than one-third that ordinarily obtained and yet good clarification resulted.

The authors question the use of lime as a clarifying agent. According to experiments carried out, less sucrose was lost with their new procedure than when milk of lime was employed. They claim about 7% higher yield of crystal sugar, greater yields of 'B' molasses with slightly higher sucrose and invert sugar and an increase in protein content or 47.1 per cent. The massecuite and molasses from the new process were also less viscous.

The encouraging results obtained led them to continue their investigations and to include the use of Separan AP — 30. The best scheme so far devised is the following : Addition of P_2O_5 in the form of triple superphosphate at the rate of 150-200 ppm in the cold, followed by adjustment to pH 7.8 with ammonia, heating to the boil plus the addition of Separan AP-30 (1.5 ppm) just as the heated juice enters the clarifier.

Apart from the advantages mentioned earlier, settling rate and clarification are improved, whilst the sugar produced is lighter in colour. The authors are convinced that the new process will go a long way towards solving the problem of evaporator scaling.

E.C.V.

CHIEN, H. C. — **Food and feed yeast in Taiwan.** (Levure pour l'alimentation humaine et animale à Formose). *Taiwan Sug.*, 1960. **7** : (2), 13-22.

A Formose comme dans beaucoup d'autres pays, l'alimentation est pauvre en protéines. Le pays importe du lait en poudre et du soja d'une valeur de 12 millions de dollars annuellement. Or la population, qui s'élève à 10 millions d'habitants, s'accroît au rythme de 3½ pour cent chaque année et 90 pour cent des récoltes se composent de canne à sucre et de riz qui ne contiennent que très peu de matières protéiques. Dans le but donc de prévenir la malnutrition, l'année dernière fut réalisé un projet de fabrication de levure. Celle-ci est un aliment extrêmement riche car, outre les protéines, elle contient des vitamines et d'autres facteurs d'une valeur nutritive exceptionnelle.

Les auteurs du projet avaient dans l'idée d'utiliser comme matière première la mélasse dont Formose produit quelque trente millions de gallons par an. Ils décidèrent aussi que le « Taiwan Sugar Corporation », disposant sur place de toutes les facilités nécessaires, devrait se charger de la construction et du fonctionnement d'une fabrique de levure. Cette dernière fut inaugurée et commença à fonctionner en 1959.

La manière de procéder est la suivante : La mélasse est diluée jusqu'à un brix déterminé, stérilisée de façon continue, puis centrifugée à grande vitesse. L'eau qu'on emploie est d'abord purifiée par sédimentation, ensuite filtrée et stérilisée. L'air qu'on doit utiliser est comprimé et passe ensuite à travers une série de filtres à coton. La mélasse additionnée de principes nutritifs purs, tels que l'urée et le sulfate d'ammoniac, ainsi que l'eau et l'air, sont envoyés dans des cuves où la levure se multiplie. Le moût qui en sort passe par des refroidisseurs et il est ensuite concentré dans des séparateurs à buses. Le concentrat est traité à l'eau puis recyclé. Finalement la levure est séchée et tamisée. Le procédé est continu. Chaque stade de la fabrication est soumis à un contrôle chimique et biologique des plus sévères.

La levure obtenue sert à fabriquer des comprimés, à enrichir la

farine de froment ou de soja, mais la plus grande partie est donnée aux bestiaux ou aux animaux de basse-cour, soit pure, soit mélangée à d'autres aliments. Une certaine portion est exportée, et des recherches ont été entreprises en vue de trouver d'autres emplois pour le produit.

E.C.V.

DOS SANTOS ILHA, J. — **Eliminating discoloration in Portuguese East Africa.** (L'élimination de la coloration des sucres en Afrique Orientale Portugaise). *Sugar y Azucar*, 1960. **55**: (10) 49.

Le sucre de sulfitation a tendance à devenir jaune lorsqu'il n'est pas consommé tout de suite.

Des études furent entreprises à la sucrerie de Bom Jésus pour déterminer les causes de ce jaunissement.

Cette décoloration résulte principalement de la présence de sels ferriques dans le jus. Lorsque celui-ci est chaulé, ces sels restent en suspension, associés à des acides organiques. A la sulfitation, ces mêmes sels sont transformés en sels ferreux incolores qui restent dans le jus et dont une partie finit par passer dans les cristaux de sucre où ils sont occlus. Lorsque le sucre sèche, les sels ferreux sont réoxidés par l'air en sels ferriques qui le colorent.

La solution de ce problème consiste à traiter le jus avec du superphosphate de calcium et le porter ensuite à un pH de 8.0. Le fer est alors précipité sous forme de PO_4HFe et le jus est ensuite sulfité jusqu'à ce que le pH tombe à 6.4 - 6.8. L'addition de superphosphate facilite en même temps la clarification et produit des boues qui filtrent facilement.

Une autre cause de changement de couleur des sucres est l'addition de Blankit aux cuites. Le Blankit ne réagit pas avec tous les composés organiques colorants du jus et certains persistent jusqu'au sucre où ils produisent un jaunissement lorsqu'ils sont réoxidés. L'emploi d'hydrosulfite F2 est préférable à celui du Blankit.

La clarification au superphosphate et l'addition d'hydrosulfite ont permis à la sucrerie de Bom Jésus de produire un sucre comparable au sucre de carbonatation.

J.P.L.

LORD, G. and DAVIS, C.W. — **Estimation of the constituents of cane by weighing cane, juice and bagasse.** *I.S.J.* 1960 **62**: 1945.

During a period of eight weeks all the cane, juice and bagasse crushed by each of two mill tandems in an Australian sugar factory were weighed separately and the data obtained for each tandem was used to calculate the composition of the cane. Servo-Balans juice scales were used for the juice and Blake-Denison belt weighers for bagasse.

The proportion of different varieties of cane and the quality of the cane milled in each tandem was very nearly the same.

The results obtained in the two tandems were ;

Brix % cane 19.42 and 19.43, pol % cane 17.53 and 17.50 and fibre % cane 12.13 and 12.24. These results were obtained with the same cane on dissimilar milling tandems producing mixed juice and bagasse at dissimilar rates and analyses. They show that the juice and bagasse weighing procedure can give closely reproducible results.

J.P.L.

CALDER, A. — **Deep litter housing for pigs**. (L'élevage du porc sur litière profonde).— *Rhodesian Agric. J.* 1960, **57** : 195-202.

La litière profonde jusqu'ici largement employée pour l'élevage des poules a été expérimentée et introduite dans l'élevage des porcs en Rhodésie avec le plus grand succès.

Les porcheries employant ce système ne font plus appel aux constructions en dur ainsi qu'il se pratiquait autrefois. L'emploi de structures en bois recouvertes de chaume est largement recommandé par les officiels du *Pig Industry Board*. Les cours ne sont plus en stuc, le sol offrant la base nécessaire à l'aménagement de la litière qui se compose d'une couche d'environ 18 pouces d'épaisseur ou plus de préférence.

L'emploi de cette méthode dans l'élevage du porc procure de nombreux avantages dont les plus importants sont :

(i) une économie importante de main d'œuvre ;
(ii) l'absorption des urines qui possèdent une grande valeur fertilisante et qui étaient jusqu'alors généralement perdues.
(iii) une plus forte production de fumier et une amélioration sensible de la qualité de cet important sous-produit de la ferme ;
(iv) réduction importante de la multiplication des mouches sur la ferme ;
(v) les animaux élevés sur litière profonde sont en général plus robustes et jouissent d'une meilleure santé que ceux élevés sur stuc d'après les méthodes conventionnelles ;
(vi) le compost ainsi produit contient une très forte proportion d'anti-biotiques et de vitamine B12 qui exercent une influence favorable sur la croissance des animaux ;
(vii) les animaux ainsi élevés ne souffrent généralement pas de faiblesse des pieds comme il en est souvent le cas sur stuc.

A.E.C.

CALDER, A.—**Sweet potatoes for pigs — Feeding techniques and management.** (La patate douce dans l'alimentation des porcs). *The Rhodesian Agric. J.* 1960. **57** : 293-7.

Il a été déjà établi que la valeur alimentaire de la patate douce était comparable à celle de la pomme de terre dans l'alimentation des porcs. Dans les pays européens ces animaux sont dans une très grande mesure alimentés de pommes de terre provenant soit de cultures spécialement faites à cet effet, soit des surplus ou des rebuts de récoltes.

Il semblerait que l'utilisation de la patate dans l'alimentation porcine n'a pas reçu toute l'attention qu'elle méritait à en juger par les superficies restreintes de cette culture de par le monde pour l'alimentation des porcs. Il est un fait que les qualités nutritives de la patate dans l'élevage porcin n'ont pas été étudiées avec autant d'attention que celles de la pomme de terre dans les climats tempérés et qu'ainsi les éleveurs des climats tropicaux ne disposent pas de renseignemets suffisants sur l'usage économique de la patate dans l'alimentation des porcs. La valeur nutritive de la patate est en bien des points comparable à celle de la pomme de terre. Les deux aliments constituent une source importante de matières hydrocarbonées dont 4 ou 5 livres de l'un ou de l'autre équivalent à une livre de grain. La patate contient environ 30% de matière sèche en comparaison d'environ 25% dans la pomme de terre. Les deux aliments ont des teneurs faibles en protéines approchant à environ 2%. La teneur en carotène qui procure la vitamine A, est élevée dans la patate et peut atteindre près de 10 fois celle généralement trouvée dans le maïs jaune. Cette forte teneur est un facteur très important dans les pays où le maïs blanc sert à l'alimentation des porcins.

Il semblerait qu'avec les méthodes actuelles de la culture de la patate les rendements obtenus ne sont pas économiques. Cela est principalement dû au fait que cette culture ne reçoit pas les soins qu'elle réclame, notamment en égard de l'utilisation des engrais.

L'auteur a entrepris une série d'expériences culturales où le purin de la porcherie était employé comme engrais liquide des cultures de patate. Il en ressort que des augmentations de rendements de l'ordre de près de 50% sont obtenus (8.5 tonnes à 11.9 tonnes). Pour que la culture de la patate devienne économique dans l'élevage porcin il suffirait d'apporter à cette culture une fumure minérale adéquate.

Un autre point très important en faveur de la patate consiste en le fait que cet aliment produit chez le porc une graisse ferme, tandis que le maïs a tendance à amollir la graisse, ce qui est un défaut grave chez les animaux devant servir à la fabrication du bacon.

A.E.C.

STATISTIQUES DES CONDITIONS MÉTÉOROLOGIQUES

NOVEMBRE 1960

A. Pluie (pouces) et différences de la normale

Période	Ouest	Nord	Est	Sud	Centre
1 — 5	0.17	0.15	0.49	0.47	0.64
6 — 10	0.02	0.22	0.09	0.24	0.22
11 — 15	0.11	0.42	0.93	0.17	1.26
1 — 15	0.30 (—0.62)	0.79 (—0.13)	1.51 (—0.31)	1.88 (—0.15)	2.12 (+0.40)
16 — 20	0.15	0.02	0.13	0.24	0.31
21 — 25	0.13	0.09	0.08	0 41	0.21
26 — 30	0.27	0.13	0.70	0.32	1.25
16 — 30	0.55 (—0.79)	0.24 (—1.00)	0.91 (—1.39)	0.97 (—1.46)	1.77 (—0.52)

B. Température (°C)—Maximum, minimum et différences de la normale

1 — 15	29.3 18.6	27.1 (—2.5) 18.0 (—0.0)	25.4 18.3	25.6 (—2.1) 19.1 (+0.3)	23.1 (—1.7) 16.4 (—0.9)
16 — 30	29.5 20.0	27.9 (—2 4) 19.3 (+0.4)	26.1 18.6	27.4 (—1.1) 19.8 (+0.4)	24.8 (—0 9) 17.9 (—0.2)

C. Vélocité (nœuds*). Moyenne quotidienne des vélocités horaires les plus élevées et maximum horaire

1 — 15	9 (14)	7 (12)	11 (15)	12 (17)	11 (15)
16 — 30	4 (8)	3 (7)	7 (11)	11 (14)	8 (14)

*Pour convertir en milles à l'heure multiplier par 1,151.

STATISTIQUES DES CONDITIONS MÉTÉOROLOGIQUES

DECEMBRE 1960

A. Pluie (pouces) et différences de la normale

Période	Ouest	Nord	Est	Sud	Centre
1 — 5	0.00	0.16	0 08	0.04	0.12
6 — 10	0.00	0.08	0.17	0.06	0.02
11 — 15	0.05	0.22	0.31	0.14	0.33
1 — 15	0.05 (−2.17)	0.46 (−1.48)	0.56 (−2.70)	0.24 (−2.88)	0.47 (−2.87)
16 — 20	0.02	0.05	0.09	0 04	0.17
21 — 25	1.70	0.80	1.07	3.27	3.86
26 — 31	0.40	0.14	0.75	0.27	0.25
16 — 31	2.12 (−1.13)	0.99 (−1.90)	1.91 (−2.83)	3 58 (−0.87)	4.28 (−0.80)

B. Température (°C)—Maximum, minimum et différences de la normale

1 — 15	32.1 21.1	30.4 (−0 6) 20 4 (+0.4)	27.5 19.7	28.4 (−0 9) 21.3 (+0 8)	27.0 (0.5) 18.9 (0 0)
16 — 31	31.7 21.8	30 5 (−0.6) 21.2 (+0.3)	28.2 20.7	29 1 (−0.7) 21.8 (+0.3)	27.4 (+0.5) 19.5 (−0 2)

C. Vélocité (nœuds*). Moyenne quotidienne des vélocités horaires les plus élévées et maximum horaire

1 — 15	5 (8)	9 (13)	7 (8)	11 (14)	11 (13)
16 — 31	10 (18)	9 (13)	8 (10)	11 (18)	9 (14)

*Pour convertir en milles à l'heure multiplier par 1,151.

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(A) *Below :* Cleaning Evaporator Tubes with a Twin Drive Machine at a Sugar Refinery.

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(B) *Below :* Removing Scale from Babcock & Wilcox Boilers in an Indian Refinery.

(C) *Below :* Cleaning the tubes of horizontal Juice Heating Plant in an Indian Sugar Factory.

(D) 'Skatoskalo' Electric, Petrol-Driven and Pneumatic Machines, rotary Scaling tools, wire brushes etc., are designed to do routine cleaning and descaling work quickly, positively and thoroughly.

(E) *Left :* Operating two machines simultaneously of the cleaning of an evaporator.

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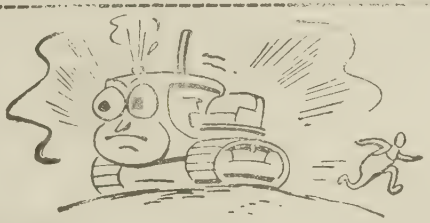

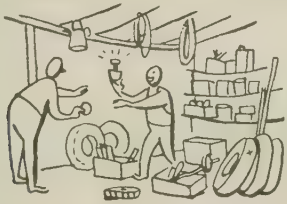

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